The Journal

OF THE

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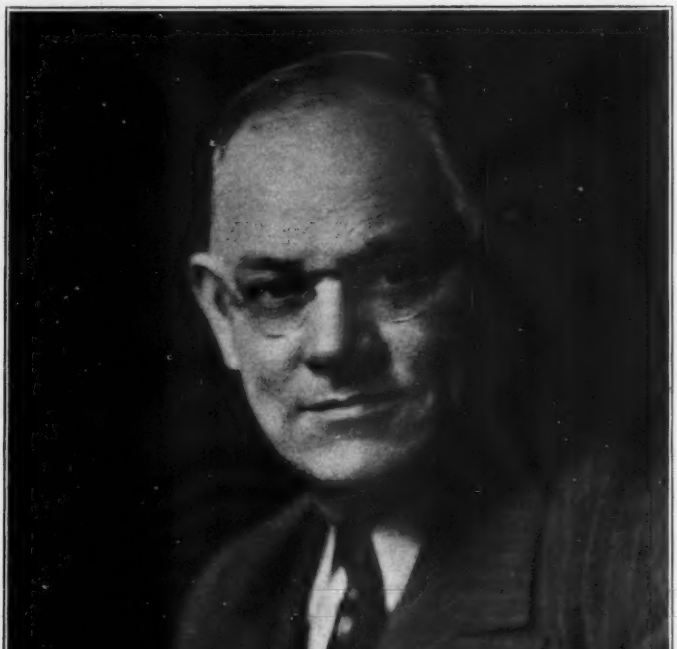

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X-RAY IRRADIATION AND OSTEONECROSIS OF THE JAWS

By FRANK F. KANTHAK, M.D., D.D.S., Chicago, Ill.

THE adverse effect of heavy x-ray or radium therapy on osseous structure is fully appreciated by radiologists and those treating tumors of the head and neck. That such irradiation presents a distinct contraindication to the extraction of teeth or other oral surgical procedures is not fully appreciated. This communication will review the effects of irradiation on osseous structure and report several illustrative cases involving the jaws.

Ewing (1926) has reviewed the reactions of bone to irradiation, a subject that deserves further investigation. Perthes, in 1903, shortly after the discovery of the roentgen rays, carried out experiments to determine the effects of these rays on living tissue. The right wing of 1-day-old chickens was exposed to roentgen rays, and, at the end of twelve days, it was found that the wing so treated was smaller than the one on the opposite side and its feathers were more sparse. In 1905, Recamier and Tribondeau showed that growth of bone in chickens could be inhibited by a dose of roentgen rays so small as to have no skin effect and afford no histologic evidence of cellular change in the bone. Cluzet, in 1910, exposed the bones of rabbits and dogs to x-rays before and after fractures. Although no erythema of the skin was produced by the dosage used, the formation of callus was absent for from twenty-one to thirty-four days in dogs and for eighteen days in rabbits. Healing, although greatly delayed, occurred with the formation of a hard callus on the side of the bones opposite the irradiated area. Regaud (1922) first called attention to the great susceptibility of the jaws to necrosis and infection during the treatment of intraoral carcinoma. He noted bony necrosis beneath uninjured skin and concluded that bone is more susceptible to irradiation than is skin. It is evident, as Watson and Scarborough (1938) point out, that heavy external irradiation causes changes in the bone and periosteum which diminish their power of resistance to infection and thus increase their susceptibility to infection and trauma. The periosteum is apparently very susceptible to irradiation. After adequate therapeutic doses of

x-rays, swelling and thickening of the periosteum occur and it can be stripped easily from the bone. Histologic examination of irradiated periosteum indicates that the inner surface is thickly hyalinized. The layer of osteoblasts usually found in the inner layer of the periosteum may be absent. Ewing has shown histologically that irradiated bone seems to present widening and irregularity of lacunae and canaliculi and a partial loss of lamellar structure. This indicates that the bone cells themselves are readily killed by irradiation and thus the entire bone suffers devitalization and alteration. In addition to these effects, there is considerable reaction of the vascular supply of the bone. The vessels tend to become thickened and are finally obliterated. In addition to the death of bone cells noted above, an aseptic type of necrosis of the bone occurs. (Fig. 1.) This reaction has most frequently been described in the femurs, following irradiation for the treatment of carcinoma of the ovary, etc. The necrosis of the bone is produced entirely on a circulatory basis without any component of infection and may be so severe as to result in pathologic fracture of the femur.

Fig. 1.—Mandible irradiated for carcinoma of tonsil. Marked mottling of the bone with areas of increased and decreased density is evident. Roots of the lower first molar are being exfoliated. These bone changes may be considered as aseptic necrosis due to the decrease in the normal vascularity of the mandible.

That these adverse effects of irradiation of oral tumors are a frequent enough complication to warrant more attention is indicated by the report of Watson and Scarborough from the Memorial Hospital of New York City. Of 1,819 patients with intraoral carcinoma treated from 1930 to 1937, 235, or 13 per cent, developed osteoradionecrosis of the jaws. Salman and Kaufman (1937) have also published a report on this subject, calling attention to the association of necrosis of the mandible with x-ray irradiation.

Three definite factors seem to be conducive to osteoradionecrosis: irradiation, infection and trauma. As indicated in the previous section, irradiation of osseous tissue tends not only to destroy the normal resistance of the tissue to infection and its response to healing, but also to alter the entire process of healing. Infection is induced by poor oral hygiene, general lack of care of the mouth and the retention of carious and broken-down teeth. Trauma is usually added to this burden by the simple extraction of a tooth. After the extraction, the socket

Fig. 2.—Left side of mandible, showing pathologic fracture in bicuspid region and marked mottling and moth-eaten appearance of bone posterior to the fracture.

shows no tendency to heal and the adjacent soft tissues seem to melt away, leaving a large portion of the bone exposed to the mouth and denuded of all soft tissue covering. Suppuration is profuse and continuous. The patient complains of continuous dull, steady pain and marked trismus. Because of the marked reduction in healing of the involved bone, little or no tendency for

Fig. 3.—Appearance of left side of mandible after removal of sequestrum with as little trauma to adjacent tissues as possible.

Fig. 4.—Mandible exposed in mouth and on face.

sequestration is evident for some time. After a long but variable interval, usually more than six months, a line of separation of the dead bone may become apparent on x-ray examination or a pathologic fracture may develop. At this stage, sequestrectomy may be indicated, consisting in the removal of all bone obviously dead, with as little disturbance of the soft tissues as possible. Usually, the sequestrum consists in a full-thickness section of the jaw, and little tendency is noted for longitudinal separation of the dead bone, which is exfoliated *en masse*.

After sequestrectomy of the mandible destroying the continuity of the jaw, it may be advisable to hold the jaw in correct occlusion with elastic traction until

Fig. 5.—Sequestration of fragment of mandible, 3 inches in length, from molar region to sigmoid notch.

Fig. 6.—Defect left by removal of sequestrum.

a certain amount of healing of the soft tissue ensues. This will reduce deformity and functional disability. Pain and trismus are ordinarily readily relieved following the removal of necrotic bone. Suppuration in reduced degree continues until all dead bone has been cast off and soft tissue healing is complete. It is important to recognize that although

osteoradionecrosis of the jaws occurs without the addition of extraction trauma, the removal of teeth has been followed frequently enough by extensive necrosis to make it a very hazardous undertaking in the patient who has received irradiation.

Because of the relatively high incidence of osteoradionecrosis of the jaws following x-ray treatment of neoplasms of the oral cavity and contiguous structures, it is evident that all infected teeth or questionable teeth should be extracted, the remaining teeth cleaned and the mouth put in as good condition as possible, prior to treatment. Since the effects of irradiation of the jaws lasts for several years or an indeterminate time,

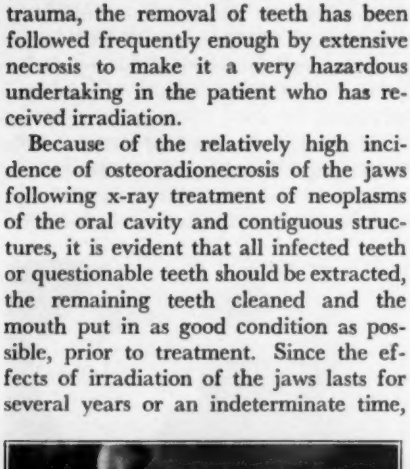

Fig. 7.—Closure of defect by sliding flaps of tissue from margins of wound.

it is often wise to remove all teeth prior to irradiation to eliminate the possibility of extraction trauma subsequent to irradiation. The feeling among radiotherapists that the fortunate patient with oral cancer is the edentulous patient is prevalent for these reasons. In addition, removal of the front teeth allows the radiotherapist to utilize intraoral x-ray radiation, which is advantageous in the treatment of certain cases of intraoral carcinoma, as that of the floor of the mouth. For the person who has received radiation therapy and has subsequently developed toothache or pain about the teeth and gums, only conservative measures should be used to treat these patients until such time has elapsed since irradiation that the removal of teeth may be considered safe. However, as stated previously, this is such an indeterminate period that unpleasant dental sequelae of caries or periodontal disease may be difficult to control.

REPORT OF CASES

CASE 1.—*History.*—A man, aged 57, was referred by his physician with the following history: In March 1939, a new growth was discovered on the left anterior tonsillar pillar which, on biopsy, proved to be a squamous-cell carcinoma. The patient received x-ray radiation in an unknown amount, directed to the left side of the neck. In May 1940, an area of leukoplakia and a continuation of the lesion were noted on the left anterior pillar, and 10 radon implants were made in the anterior pillar at the base of the tongue to supply interstitial radiation to the lesion. One month later, complaining of a toothache, the patient visited his dentist, who extracted the lower left first molar. Almost immediately after the extraction, the patient complained of increasing pain and soreness. The soft tissue overlying the mandible sloughed away, leaving the bare bone exposed to the mouth. Profuse suppuration and marked trismus ensued, permitting only a one-quarter inch movement of the jaws.

Examination.—When first seen, the patient was miserable. Continuous dull pain requiring sedatives was present, trismus was marked and suppuration was constant. The patient had lost 18 pounds. The soft tissues of the mouth were very sensitive to palpation. It was noted that a portion of the mandible measuring about 1½ inches in length was lying exposed to the oral cavity. (Fig. 2.) A soft, fluctuant swelling was present in the neck anteriorly from the sternocleidomastoid muscle over the diagastric triangle. An x-ray picture revealed a pathologic fracture of the mandible in the bicuspid region with a markedly moth-eaten appearance of the bone posteriorly almost to the sigmoid notch.

Diagnosis.—The diagnosis was osteoradionecrosis of the mandible, with cervical abscess.

Treatment.—Under avertin anesthesia sup-

plemented by deep procaine block, the jaws were pried open and the necrotic portion of the mandible was removed. This represented a full-thickness section of the jaw about 1½ inches in length. (Fig. 3.) All obviously dead or diseased bone was removed with a rongeur. Very little bleeding followed. The cervical abscess was incised and drained of about 15 cc. of foul yellow pus. Fenestrated rubber tubes were inserted and a bandage was placed. Postoperatively, the jaws were held in optimum position with elastic traction until healing took place.

Outcome.—Pain and discomfort were immediately relieved, trismus was reduced and, for the first time in months, the patient could eat without suffering.

CASE 2.—*History.*—A colored woman, aged 39, had trismus, pain and swelling of the left mandible and suppuration into the mouth. In 1937, the left submaxillary salivary gland was removed (diagnosis: carcinoma of salivary gland) and, after this operation, the patient received an unknown amount of x-ray radiation on that side of the neck. In January 1939, about fifteen months after operation, she had pain in the lower left second molar and her dentist extracted the tooth. Three days after the extraction, the patient again visited her dentist, who treated her for several weeks thereafter for "dry socket." This wound showed no disposition to heal and the mandible was curetted. Thereafter, the soft tissues overlying the mandible both intraorally and extraorally sloughed, leaving the angle of the mandible and a portion of the body and ascending ramus exposed. (Fig. 4.)

Examination.—The patient complained of almost constant severe pain in the jaw, and there was marked trismus, with suppuration. She was obtaining relief from pain by the use of morphine sulfate, and, because it was feared that she was developing an addiction to morphine, other non-narcotic anodynes were prescribed for pain relief.

Operation and Outcome.—Five months after the abortive curettage took place, the mandible from the bicuspid region to the sigmoid notch was removed as a sequestrum. (Figs. 5 and 6.) The pain and trismus were almost immediately relieved. The soft tissue defect remaining on the face was closed by sliding flaps of tissue and a satisfactory result was obtained after several corrective procedures. The lower jaw was held in position by elastic traction for several months and the traction then discontinued. At the present time, the patient is entirely free of disease and has a well-functioning mandible.

SUMMARY

The adverse effects of x-ray irradiation of bone consist essentially in a reduction of vitality and circulation of the osseous tissue and the periosteum, rendering the jaws more susceptible to extensive infection and necrosis. The conditions responsible for necrosis of the jaws are irradiation, infection and trauma. The two cases cited illustrate the hazards of extracting teeth in patients who have received extensive x-ray or radium therapy directed to the face or jaws for the treatment of carcinoma.

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AN ANALYSIS OF THE ORAL SURGERY RECORDS OF THE UNIVERSITY OF MINNESOTA SCHOOL OF DENTISTRY

By CHARLES A. GRIFFITH,* D.D.S.; AMBERT B. HALL, D.D.S., and WILLIAM J. SIMON, D.D.S., Minneapolis, Minn.

INTRODUCTION

ALTHOUGH the University of Minnesota School of Dentistry is encouraging a wide variety of research projects in physical and biologic relations, the previous direct undertakings have emphasized the necessity for the application of statistical methods or mathematical logic to the analysis and interpretation of biologic variation. The determination of the law underlying concomitant variation is a problem to all the sciences. However, the physical sciences have the advantage over the biologic sciences in that errors of observation are usually small in comparison with the measures involved, and fewer factors are ordinarily present. All knowledge is constantly undergoing modification, and new facts are constantly being established, so that it is only by constant biometric efforts that statistics, reflecting the condition and growth of a science, can from day to day remain a perfect mirror of its progress. Statistical methods were devised initially for the analysis of observational data concerning physical and biologic phenomena occurring under circumstances free from any intentional control of the forces determining the variations which characterize the phenomena, in order to provide a rigorous foundation for further statistical research. With the increasing popularity of the statistical method as an analytic tool in scientific research, a few men in the field of dental science have devoted themselves in recent times to the development and exposition of this method. There are those in the field of dental science that use statistical methods merely to portray the facts of their investigations, and there are those in the same field who resort to mathematical logic to aid in the discovery of new truths.

PROBLEM AND SOURCE OF DATA

This analysis represents an effort to apply to problems of oral surgery the same scientific statistical methods that are employed in the study of other fields of biologic science. Noting the marked advancement in drug therapeutics since 1938, it was thought that before indicative or contra-indicative information concerning the therapeutic value of the new drugs in the field of dental science could be obtained, a survey of the problems of oral surgery prior to the advances of modern therapeutics should be thoughtfully studied. Obviously, the accumulation of data is the first step in this problem.

The records of the Division of Oral Surgery lend themselves readily to statistical methods for three reasons:

1. The accuracy with which the records are kept.

2. The simplicity of the coding system adopted by the faculty of that department.

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3. The clinical disposition made of the records upon completion of the case.

The clinical records from September 27, 1937, through twelve months of full-time operation by the Division of Oral Surgery, were selected as the source of material for this analysis. The number of records accumulated during this period is 7,811.

Of the 7,811 adult patients registered during this prescribed period, 2,000 were referred to the Division of Oral Surgery for extractions. Briefly, one out of approximately four registered adult patients of the University of Minnesota School of Dentistry are referred to the Division of Oral Surgery for the extraction of teeth. The extra-routine duties of the department of oral surgery, such as procaine injections for the Division of Operative Dentistry and for the Division of Crown and Bridge, extractions for the department of children's dentistry, consultations in the Division of Oral Diagnosis and surgical assistance to the Division of Oral Pathology, are not considered in this survey.

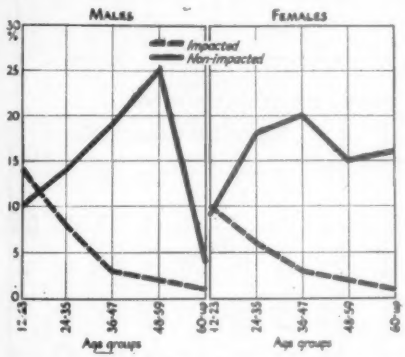

Fig. 1.—Percentage of postoperative treatments for impacted and non-impacted teeth according to age groups and sex.

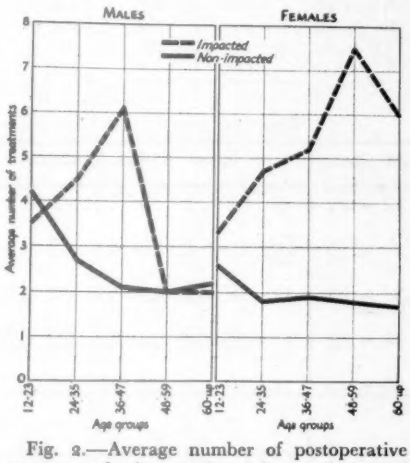

Fig. 2.—Average number of postoperative treatments for impacted and for non-impacted teeth according to age groups.

ANALYSIS AND RESULTS

Of the 2,000 patients coming to the Division of Oral Surgery, 968 were males and 1,032 were females. The average age of the male patients is 38 years, and the ages range from 12 to 89. The average age of the female patients is 36 years, and the ages range from 12 to 78 years. The total number of extractions from this group of 2,000 patients is 7,204. From the 968 male patients, 3,337 teeth were extracted, which is an average of three to four extractions per patient. From the 1,032 female patients, 3,867 teeth were extracted, which also is an average of three to four extractions per patient.

The age range for the male patients and the age range for the female patients have been divided into increments of twelve, so that what will be designated as the first group is composed of male or female patients from 12 to 23 years of age. The second group is composed of male or female patients from 24 to 35 years of age. The third group is composed of male or female patients from 36 to 47 years of age. The fourth group is composed of male or female patients from 48 to 59 years of age. The fifth and last group is composed of male or female patients 60 years of age and over. By determining the number of

extractions per age group for both sexes, it is possible to compute the average number of extractions and the average number of missing teeth per patient per age group. Table 1 has been prepared to illustrate these considerations.

same age will average one to two extracted teeth. Concomitantly, a female patient attaining the age of 60 or over will average more missing teeth than a male of the same age.

The subsequent analysis will determine the frequency of each tooth extraction and not the average number of teeth extracted.

TABLE 1.—AVERAGES FOR EXTRACTIONS AND FOR MISSING TEETH

Age Range Groups (Male and Female)	Number of Patients		Number of Extractions		Average Number of Extractions per Patient		Average Number of Missing Teeth per Patient	
	Male	Female	Male	Female	Male	Female	Male	Female
I (12-32)	283	270	510	545	1–2	2–3	1–2	2–3
II (24-35)	178	228	428	598	2–3	2–3	3–5	4–6
III (31-47)	180	274	790	1297	4–5	4–5	7–10	8–11
IV (48-59)	187	187	951	1049	5–6	5–6	12–16	13–17
V (60-up)	140	73	658	378	4–5	5–6	16–21	18–23

TABLE 2.—PERCENTAGE FREQUENCY OF TEETH EXTRACTED (MALES 968).

Age Group	Upper Right Quadrant								Upper Left Quadrant							
12 – 23	4	3	8	4	3	1	3	4	4	6	1	3	10	11	5	7
24 – 35	(13)	11	8	10	13	6	8	8	7	10	7	8	7	10	13	(16)
36 – 47	11	16	11	12	16	22	22	16	17	19	21	(17)	13	(15)	16	11
48 – 59	10	(28)	(12)	(16)	(18)	(29)	(28)	(27)	(29)	(20)	(26)	17	(18)	13	17	7
60 – up	2	16	9	11	11	23	17	18	21	18	20	12	14	11	(18)	8
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
12 – 23	9	8	(14)	2	2	1	1	1	2	1	1	2	3	(17)	7	7
24 – 35	(15)	9	8	6	4	1	2	3	3	1	1	3	5	6	8	(9)
36 – 47	11	15	12	13	15	13	11	13	10	11	13	12	12	7	11	5
48 – 59	11	(17)	10	(16)	(20)	18	17	(16)	16	17	18	16	12	14	(17)	9
60 – up	7	12	10	9	18	(24)	(23)	15	(17)	(21)	(26)	(20)	(19)	7	12	5
	Lower Right Quadrant								Lower Left Quadrant							

In this table, the significant differences between the sexes lie in Groups I and V. A female patient, upon attaining the age of 23, will average two to three extracted teeth, whereas a male of the

To demonstrate the percentage frequency of extraction of each tooth from

the complete dentition according to age groups outlined above, Tables 2 and 3 have been prepared.

A circled figure in these tables indicates the age group at which the greatest number of that particular tooth are extracted. A perusal of these tables reveals that, most frequently, the first teeth lost to both sexes are the lower first permanent molars and the last teeth are the lower anterior incisors, which is collaborative evidence of the findings of previous investigators,[1] enhancing the statistical reliability of this analysis. In the matter of sexual differences, it is noted that the females more frequently sacrifice their upper teeth at an early age than the males, although both sexes lose their upper teeth sooner than their lower teeth. Unique is the demonstration of the lack of bilateral symmetry of extractions between the upper left and right quadrants and between the lower left and right quadrants; that is, unique in the sense that it bears out clinical observations and not previous statistical surveys.

Thus far, the material presented has been basic in that it has dealt with the generalities of ranges, averages and frequencies. One of the more specific problems is that of impactions.

Two per cent of 7,204 teeth extracted were impacted, an average of one impaction per fourteen patients, and the average age range at which the greatest number of these impacted teeth are removed is 24 to 35 years. Table 4 presents the percentage of locations of all the impacted teeth removed according to sex.

The term miscellaneous includes teeth impacted elsewhere in the arch, such as incisors, bicuspids and molars, as well as supernumerary teeth. It is noteworthy that at least 64 per cent of all the impacted teeth removed are lower third molars, irrespective of sex as demonstrated in Table 4. Also, there is a 1:2 ratio of impacted upper third molars

TABLE 3.—PERCENTAGE FREQUENCY OF TEETH EXTRACTED (FEMALES 1032).

Age Group	Upper Right Quadrant								Upper Left Quadrant							
12 - 23	10	6	9	6	6	4	7	6	7	6	5	6	7	12	9	10
24 - 35	(12)	9	8	10	9	8	8	10	9	10	9	10	10	9	9	(13)
36 - 47	11	(20)	12	(16)	(18)	19	(20)	18	(20)	(19)	17	15	14	13	17	12
48 - 59	8	18	(13)	15	18	(21)	19	(20)	20	16	(20)	(16)	(18)	(16)	18	8
60 - up	4	10	10	9	13	18	14	18	20	15	19	7	15	15	(19)	5
	8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
12 - 23	11	6	(16)	4	1	1	1	1	1	1	1	1	4	(14)	11	11
24 - 35	(17)	8	7	4	3	3	5	5	5	4	3	4	5	7	11	(15)
36 - 47	12	10	11	12	15	16	16	16	18	18	14	12	12	7	13	9
48 - 59	4	(18)	12	(20)	(23)	23	25	24	23	25	25	21	(23)	9	(16)	8
60 - up	4	10	9	18	23	(36)	(30)	(32)	(30)	(30)	(33)	(23)	9	4	10	5
	Lower Right Quadrant								Lower Left Quadrant							

and a 2:1 ratio of miscellaneous impacted teeth removed in males as compared to females.

Retrospectively, surgical work is not accomplished without occasional intrinsic and extrinsic complications. It is not within the scope of this analysis to determine the etiology of complications (dry sockets, etc.) following the extraction of teeth. However, the postoperative treatment rendered in the Division of Oral Surgery of the University of Minnesota School of Dentistry is characterized by an homology which permits a retally of the findings in vindication of the percentage frequency. In the analysis to follow, the postoperative complications that occur after the surgical removal of an impacted tooth have been segregated from the postoperative complications that occur after a routine extraction. In 6 per cent of the total number of teeth extracted (3,337), impacted teeth included, from male patients (968), postoperative treatment is required. In 8 per cent of the total number of teeth extracted (3,867), impacted teeth included, from female patients (1,032), postoperative treatment is required. Table 5 lists these figures according to sex and segregates impacted teeth from non-impacted.

Briefly, from four to six extractions (impactions excluded) out of every hundred routine extractions require special postoperative treatment.

In order to indicate the various areas of the mouth where postoperative complications arise, Table 6 has been prepared, showing the percentage of sockets requiring special postoperative treatment in the upper and lower, right and left, posterior segments of the arches, and in the upper and lower anterior incisor region of the arches, according to sex.

It is axiomatic that in the area where the greatest number of impacted teeth are removed, the greatest number of sockets will require special postoperative treatment. However, Table 6 reveals a significant sex difference in regard to the areas requiring special postoperative treatment when routine extractions are

TABLE 4.—LOCATION OF IMPACTED TEETH

Location of Impacted Tooth			Impacted Teeth Removed Per Cent	
			Male	Female
I. Upper third molars			9	18
		Right | Left		
	Male	6% | 3%		
	Female	10% | 8%		
II. Lower third molars			64	69
		Right | Left		
	Male	42% | 22%		
	Female	31% | 38%		
III. Miscellaneous impacted teeth			27	13
		Super-Numerary | Miscellaneous		
	Male	8% | 19%		
	Female	1% | 12%		
			100	100

studied independently of surgically complicated impactions. In the male patient, of the areas where sockets require special postoperative treatment (impactions omitted), the most common is the upper anterior incisor region of the arches. In the female patient, of the areas where sockets require special postoperative treatment (impactions omitted), the most common is the lower right or left posterior segment of the arches.

The accompanying graphs illustrate the relationship between age and the percentage of sockets requiring special postoperative treatment (impactions segregated) according to sex.

One of the generalizations to be made from Figure 1 is that patients from 12 to 23 years of age, irrespective of sex, more frequently require postoperative treatment after the extraction of impacted teeth than patients in the more mature age groups. Another generalization to be made from this graph is that after the extraction of a non-impacted tooth, socket complications arise more frequently in patients of both sexes whose age range is from 36 to 59 years.

The determination of the percentage frequency of the total postoperative treatment for impacted and non-impacted teeth according to age groups and sex leads to the next determination, which is the average number of postoperative treatments for impacted and non-impacted teeth according to age groups and sex. (Fig. 2.)

The average number of special postoperative treatments required after the extraction of a non-impacted tooth are approximately the same for both sexes, and in accordance with their respective age groups. However, a female patient 48 to 59 years of age requires at least four times the average number of postoperative treatments that a male patient

TABLE 5.—PERCENTAGE OF IMPACTIONS AND EXTRACTIONS REQUIRING POSTOPERATIVE TREATMENT

	Male (968) Per Cent	(Female 1032) Per Cent
Impactions	2	2
Extractions	4	6
	6	8

TABLE 7.—PERCENTAGE OF SOCKETS SUTURED

	Maxilla	Mandible
Male	59	41
Female	51	49

TABLE 6.—PERCENTAGE OF SOCKETS REQUIRING SPECIAL POSTOPERATIVE TREATMENT

	Upper Right Posterior Segment		Upper Anterior Incisor Region		Upper Left Posterior Segment	
	Male	Female	Male	Female	Male	Female
Impactions	0	1	4	2	0	1
Extractions	7	11	19	9	11	12
Totals	7	12	23	11	11	13
	Lower Right Posterior Segment		Lower Anterior Incisor Region		Lower Left Posterior Segment	
	Male	Female	Male	Female	Male	Female
Impactions	14	7	1	0	8	8
Extractions	11	20	9	13	16	16
Totals	25	27	10	13	24	24

of the same age requires after removal of an impacted tooth.

No attempt is made in this record analysis to evaluate the various types of postoperative treatment; for, as stated, the necessity for drug therapy must be fully recognized before an evaluation of the therapeutic properties of drugs can be correlated. There remains another factor in the frequency of postoperative complications and that is the effect of suturing. There is no hard and fast rule in the Division of Oral Surgery of the University of Minnesota School of Dentistry as to when a suture should be placed. The placement of a suture rests with the faculty member in charge of the surgical procedure. Nevertheless, 15 per cent of all sockets (7,204) from which teeth have been removed are sutured. Where the sutures are placed according to sex is indicated in Table 7.

In order to study thoroughly the effect of this suturing in retardation of postoperative complications, it was necessary to separate the total number of sutured cases from the total number of non-sutured cases requiring special postoperative treatment for both sexes. (Table 8.)

The difference (18 per cent) can be interpreted to mean that while suturing does not entirely eliminate the postoperative complication, a suture will reduce the number.

This analysis concludes the material to be compiled for this treatise. Because of the autonomous manner in which this analysis has been presented, a summary of the highlights will be set forth, not as conclusions, but as an outline from which facts can be substantiated.

TABLE 8.—PERCENTAGE OF CASES OF EXTRAORDINARY POSTOPERATIVE TREATMENT

			Male	Female
I. Non-sutured			59	64
		Male	Female	
	A. Non-impacted	42	54	
	B. Impacted	17	10	
II. Sutured			41	36
		Male	Female	
	A. Non-impacted	31	27	
	B. Impacted	10	9	
		Differences	18	18

SUMMARY

1. Of 7,811 registered adult patients of the University of Minnesota School of Dentistry, 2,000 were referred to the Division of Oral Surgery for extractions; i.e., one out of approximately four.

2. Of the 2,000 patients referred to the Division of Oral Surgery, 968 were males and 1,032 were females. The average age of the male patients is 38 years; the average age of the female patients, 36.

3. The total number of extractions in this group of 2,000 patients is 7,204. A female patient aged 23 will average two to three extracted teeth; whereas, a male patient of the same age will average one to two extractions. Concomitantly, a female patient aged 60 or over will average more missing teeth than a male patient of the same age.

4. Most frequently, the first teeth lost to both sexes are the lower first perma-

nent molars; the last teeth, the lower anterior incisors. More frequently, the females sacrifice their upper teeth at an early age than do the males; although both sexes lose the upper teeth sooner than the lower.

5. Two per cent of the 7,204 teeth extracted at the University of Minnesota School of Dentistry are impacted; an average of one impaction per fourteen patients; and the average age at which the greatest number of these impacted teeth are removed is 24 to 35 years. At least 64 per cent of all the impacted teeth removed are the lower third molars.

6. It is not within the scope of this analysis to determine the etiology of complications (dry sockets, etc.) following the extraction of teeth; however, complications develop more frequently in females than in males. Generally, four to six extractions (impactions excluded) out of every hundred routine extractions require special postoperative treatment.

7. It is axiomatic that in the areas where the greatest number of impacted teeth are removed, the greatest number of sockets will require special postoperative treatment. In the male patient, the area where sockets require special postoperative treatment most frequently (impactions omitted) is the upper anterior incisor region of the arches. In the female patient, the area where sockets require special postoperative treatment most frequently (impactions omitted) is the lower right or left posterior segment of the arches.

8. A socket complication follows extraction of a non-impacted tooth more frequently in patients, irrespective of sex, whose age range is 36 to 59 years.

9. The average number of special postoperative treatments required after the extraction of a non-impacted tooth is approximately the same for males and females and in accordance with their respective age groups. However, a female patient 48 to 59 years of age requires at least four times the average number of postoperative treatments that a male patient of the same age requires after removal of an impacted tooth.

10. There is no hard and fast rule in the Division of Oral Surgery as to when a suture should be placed. Fifteen per cent of all the sockets (7,204) from which teeth have been removed are sutured. Sutures are more frequently placed in the maxilla than in the mandible, in both sexes.

11. In studying the effect of suturing in retarding postoperative complications, it was found that while suturing does not entirely eliminate postoperative socket complication, a suture will reduce the number.

12. No attempt is made in this analysis to evaluate the various types of postoperative treatment. The necessity for drug therapy must be fully recognized before an evaluation of the therapeutic properties can be correlated by means of the scientific statistical methods that are now employed in the study of other fields of biologic science.

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A CASE OF VINCENT'S INFECTION ASSOCIATED WITH ERYTHEMA MULTIFORME

By J. P. Morrison, D.D.S., Philadelphia, Pa.

ERYTHEMA multiforme may be defined as an inflammatory disease of an acute character, characterized by reddish or purplish red, often variegated macules, papules and tubercles, occasionally becoming vesicular or bullous, and occurring as numerous scattered or grouping lesions of various sizes and shapes.[1]

Prinz and Greenbaum[2] say that the disease is due to intoxication by drugs, foods or bacteria, or to intestinal toxemia. According to Cecil,[3] some investigators associate it with foci of infection in the teeth, tonsils and sinuses. Mead[4] calls attention to the fact that among the skin diseases which may be due to oral sepsis are alopecia areata, purpura and erythema multiforme. The disease is known to occur predominantly, according to Andrews,[5] in the spring and fall of the year. The prognosis is good, although recurrence is not uncommon.

Treatment consists of internal administration of sodium salicylates. Sulfathiazole is also evidently of some value. A mouthwash of equal parts of peroxide and water should be used.

A case of Vincent's infection associated with unusual skin manifestations prompted a review of the recent literature on this subject.

Vincent's disease associated with erythema multiforme is of infrequent occurrence. There is a paucity of medical literature on lesions of the skin associated with Vincent's infection and I have been unable to find any mention of this association in the dental literature. However, I was able to find a few references in the general medical literature. Even textbooks by Pusey, Sutton[6] and others give but scant mention of such occurrences.

I am reporting a severe case of Vincent's infection of the mouth, associated with erythema multiforme recently treated in the Mount Sinai Hospital, Philadelphia, Pa.

Read before the staff conference of the Mount Sinai Hospital, Philadelphia, Pa., April 24, 1941.

REPORT OF CASE

History.—J. Z., a well developed and well nourished white man, aged 23, was admitted to hospital February 15, 1941. He was in moderate distress, exhibiting a widespread vesicular stomatitis and vesicular lesions on the glans penis. In the past four or five years, during the spring and summer months, he had had similar recurrent mouth lesions which, on ocasion, were associated with skin lesions on the upper extremities and the glans penis.

Examination.—On admission, the vesicular lesions involved the entire buccal and gingival mucosa, the hard and soft palates and pharynx. Some of the vesicular lesions had coalesced and broken down, producing a foul-smelling discharge. Similar lesions were found on the glans penis. The patient complained of painful swallowing and salivation. The cervical and axillary glands were somewhat enlarged. The temperature ranged from 101 to 103° F. Leukocytosis was present, with a 15,900 white cell count, 75 per cent polymorphonuclears and a 7 per cent eosinophils.

There were no gross abnormalities of the head, ears, chest, lungs, heart, abdomen or extremities. The eyes were reddened, with

a mucopurulent discharge associated with tears and smarting, suggesting an acute catarrhal conjunctivitis.

The mucous membranes of the nose were moderately swollen and injected. Small vesicles were present with a viscid discharge, apparently due to rupture of the vesicles. The condition of the mucous membrane was considered by the rhinologic consultant to be of infectious rather than of allergic origin.

The medical and family history were not significant. Four years previously, the patient had been treated for acute gonorrhea, in the genito-urinary clinic, and concurrently for a Vincent's infection, in the dental clinic. He returned intermittently over a period of three years for treatment of recurrent Vincent's infection.

Two days after admission to the hospital, the patient was seen by the dental consultant. The temperature was still elevated and irregular, ranging from 101 to 103° F. Salivation was accompanied by drooling. The patient appeared quite ill and abject. He complained that he was unable to eat solids because of pain. He coughed frequently and expectorated a great deal of greenish viscid material during the examination. His cheeks were swollen and the entire face was a dusky hue. A few discrete hemorrhagic erythematous iris-shaped eruptions were present on the face. The lips were somewhat swollen and covered with a dark brownish exudate. The patient was unable to fully open his mouth, and the tongue was heavily coated and presented a number of vesicles. Hemorrhagic spots were present on the oral aspects of the lips. The gums were covered with a grayish white membrane, which bled freely at the gingival crests and extended over the buccal mucosa of both sides, from which there was slight bleeding. The vesicular lesions had coalesced and were confluent on the hard and soft palates and pharynx.

Examination of the glans penis disclosed broken down vesicles, with angry red lesions present, and painful urination.

Laboratory Findings.—A smear from the exudate of the mouth on admission showed no Vincent's organisms, but a smear taken two days later from the deeper subgingival tissues showed numerous fusiform bacilli and many spirillae, with pus cells.

Examination of the blood showed a leukocytosis (15,900 cells) on the day of admission, with a drop to 11,600 cell two days later. After seven days, normal levels were reached. Urinalyses and blood cultures gave negative results. The Wassermann and Kahn tests were negative.

Treatment and Course.—The consulting dermatologists confirmed the diagnosis of erythema multiforme, and expressed the opinion that the condition was of a toxic, infectious nature. They suggested treatment with sulfathiazole, which was given for a period of nine days, 15 grains every four hours. The mouth was swabbed with a 2 per cent gentian violet solution and was washed three times daily with a solution of equal parts of hot hydrogen peroxide and water. At intervals, a mouthwash consisting of a 1:8,000 solution of potassium permanganate was also used. The glans penis was painted with 2 per cent gentian violet and black mercurial lotion.

Improvement of the stomatitis and lesions on the glans penis was accompanied by subsidence of the temperature. After twelve days in the hospital, the patient began to improve clinically, and, after twenty days, he was sufficiently well to be discharged from the hospital. He was discharged from the dental clinic as completely cured, approximately one month after admission.

COMMENT

As previously mentioned, there is a scarcity of case reports on the association of Vincent's infection with skin manifestations in the medical literature.

Chick and Witzberger[7] reported the case of an 11-year-old boy, with erythema multiforme accompanied by Vincent's infection. In a case reported by Caskey,[8] the diagnosis was Vincent's infection with toxic erythema.

Two cases of Vincent's fusospirillary dermatitis were reported by Greenbaum,[9] one involving the external auditory canal and the other the hands and the vulva. Crance[10] reported a case of Vincent's infection associated with an erythema multiforme-like eruption. Lester and Jacob Rosenberg[11] reported a case of erythema multiforme with stomatitis and conjunctivitis.

To judge by the descriptive details of some of the case reports, the severity of the involvement of the skin is not necessarily proportional to that of the buccal mucosa. In our case, the lesions of the mucosa in the mouth were quite severe, while the skin lesions were scattered and mild, with the exception of the eruption on the glans penis.

It is perhaps unnecessary to stress the fact that the usual method employed in taking smears for Vincent's organisms with cotton applicators is inadequate, as only the superficial tissues are reached. Vincent's organisms are anaerobic and therefore seek the lowest level of the tissues. The following method is recommended: A sterile metal loop is gently inserted at the gingival crest and forced down along the side of the tooth as deeply as it will penetrate, thus reaching the bacteria in the deeper tissues.

The pathogenic rôle of the Vincent organism is well known. In most instances, it acts as a secondary invader in tissues rendered less resistant than normal by an existing pathologic process. However, in some instances, it appears to represent a true primary infectious agent.

Stellwagon,[1] Mracek[12] and other dermatologists have stated that erythema multiforme is a systemic disease of infectious origin. In a patient with skin sensitivity, it may well be that the action of the toxins liberated from a severe primary Vincent's infection can produce erythema multiforme. This may have been the sequence of events in our case. In confirmation of the foregoing, Moser[13] mentions five instances of acute iritis associated with chronic Vincent's infection which cleared up after the mouth lesions were treated.

SUMMARY AND CONCLUSIONS

1. The association of Vincent's infection of the mouth with erythema multiforme may well be more prevalent than it is usually considered.

2. Vincent's disease should be thought of as a possible source of focal infection in the production of erythema multiforme.

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FRACTURED PERMANENT ANTERIOR TEETH COMPLICATING ORTHODONTIC TREATMENT

By D. D. GLUCKSMAN, D.D.S., New York, N. Y.

CORONAL fracture of one or more anterior teeth is so common in certain types of malocclusion, especially Class II, Division I (Angle), that it may be regarded as one reason for the early treatment of this deformity. In 100 cases of this type, taken in routine order from treated cases in my collection, eleven were found to have fractured teeth, and, of these, ten were single fractures, in one case fracture of both central incisors. They all occurred at play, where accidents, such as being struck with a ball or bat or falling, are frequent.

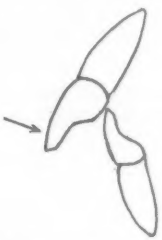

Fig. 1.—Position of central incisors in Class II, Division 1; showing direction of force on upper central incisors causing fracture, owing to lack of support from mandibular teeth.

The tooth most commonly affected is the upper central incisor. The accident usually occurs prior to active orthodontic treatment, and before the lateral incisor has erupted. Early orthodontic interference in mouths of this type, with the purpose of changing the angle of inclination of the incisors and bringing the lower incisors into a position of occlusion with them, will provide the necessary support and strength to minimize the effect of possible trauma to these teeth. In Figure 1, the upper anterior teeth are unsupported by the lower and hence are easily injured.

In many cases in which early treatment has been advised partly because of the vulnerable position of the central incisors, the advice has not been followed. A number of these patients have returned later with fractured teeth.

In none of our cases did a fracture occur during the time an appliance with bands on the anterior teeth was worn.

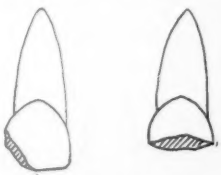

Fig. 2.—Usual types of coronal fracture involving dentin, but not pulp. The root is not involved.

This cannot be considered entirely coincidental. I believe that bands and a labial appliance greatly strengthen the resistance of the dental structures to trauma. However, the orthodontist or dentist frequently sees fractured teeth. Should there be no malocclusion present, the restoration can be made by the dentist in the esthetic manner suggested by Brauer in his recent book "Dentistry for Children." This type of restoration, a three-quarter basket crown with a labial window filled with silicate, will fulfil all requirements until the patient is old enough for a permanent prosthesis, usually a porcelain jacket crown.

The following procedure is useful,

however, in cases that require orthodontic treatment and have suffered a coronal fracture of an incisor without pulp involvement, but with dentin exposed (the most common variety). The area is roentgenographed to determine the extent of the damage and to locate possible root involvement or fracture, and to visualize the relationship of the pulp to the fracture. The tooth is tested for vitality and a record made of the response to the pulp tester. This is compared to later recordings and the prognosis is based on improved readings. Some cases do not respond favorably at first, but many gradually return to complete vitality. We had one case, treated at the Mt. Sinai Hospital Orthodontic Clinic, New York, in which the vitality returned after seven months. The initial pulp response was negative and the progressive readings steadily mounted to normal. During this time, the tooth turned dark because of extravasation of blood into the dentinal tubules (degeneration of hemoglobin). This condition also gradually cleared up and the tooth, after one year, is the same shade as the unaffected teeth on each side of it.

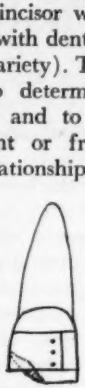

Fig. 3.—Chrome steel band fitted and welded, then refitted.

Fig. 4.—Steel strip 0.008 by 0.250 by 0.500 inch welded on labial surface and refitted on tooth.

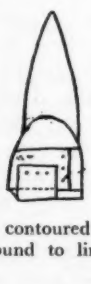

Fig. 5.—Strip contoured to form incisal edge brought around to lingual aspect and welded to band.

For a period of about one week, the tooth is covered with a celluloid crown form and sedative dressing, and if, during this time, the tooth has become stable and evidences no symptoms of pulpitis, the restoration is carried out, with subsequent orthodontic therapy.

Fig. 6.—Completed band (shaded area) ready for welding of attachment used.

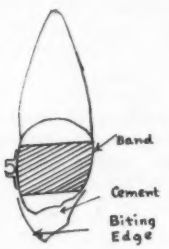

Fig. 7.—Cross-section showing band with snap channel attachment on labial and metal biting edge. The incisal biting edge is 0.008 by 0.025 inch; the band, 0.003 by 0.170.

A band is fitted to the adjacent sound tooth. If both teeth are fractured, one is built up with cement in order that a stronger band can be constructed. The band can be quickly and accurately

made by welding. The band is fitted tightly to the tooth, pinched on the lingual aspect, lapped over about 1 mm. and welded. It is then refitted on the tooth. For the construction of a biting edge, we use a strip of steel 0.008 by 0.250 by 0.5 inch. This is welded, as seen in Figure 4, on the labial surface, refitted to the tooth and bent at the incisal level of the adjacent central incisor. With contouring pliers, the steel strip is brought into position on the lingual surface of the band, and the two removed from the tooth and welded. The excess material is trimmed off, and the band with the incisal edge attached is again fitted to the tooth. At this time, we determine the type of appliance and anterior attachment to be used and this is welded to the band in its proper position. For this type of band, the snap channel tie lock is useful. We have modified this attachment in that we weld instead of solder it.

The restoration can be cemented in place with ordinary cement and eugenol and will stay in place as long as desired. It is advisable to use an excess of cement in order to fill and strengthen the space between the biting edge of the band and the fractured tooth. The excess is then trimmed to proper shape. The fractured crown is then adequately protected and restored, and orthodontic treatment may be carried on to completion.

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MECHANICAL PRINCIPLES APPLIED TO PARTIAL DENTURE CONSTRUCTION

By E. R. GRANGER, D.D.S., Mt. Vernon, N. Y.

AT the annual Chicago Dental Society meeting last winter, a well-known clinician stated that all partial dentures are regulating appliances and just a step on the road to full dentures. While this is without doubt a literal fact in a large majority of present-day cases, the implication that the full denture is an essential result of partial denture service is by no means true.

Partial denture prosthesis is primarily an attempt to solve a physiologic problem by mechanical means. It is an attempt to restore parts of a unit whose principal function is mastication by means of occlusion. It is axiomatic that the health of any organ depends on its function. Nature will tolerate those parts that function in a normal manner and attempt to dispose of those parts that do not function as they were designed to do.

The only function of teeth that can exert any influence upon their health is mastication, which, in turn, is brought about by occlusion. Occlusion involves the exertion of force by and on the teeth and their supporting structures. It follows, then, that the functional health of teeth depends on the exertion of force. This, of course, excludes a pathologic

Read before the American Academy of Restorative Dentistry, Cleveland, Ohio, September 7, 1940.

process, such as caries, which, as far as we know, is not a functional disease. As we shall see in a moment, the entire parodontium is an integrated unit, carefully designed to transmit and receive definite forces.

It is generally believed that the presence of an average clasp does cause caries; which accounts for the loss of many abutments; but if, for the moment, we assume that this is preventable, there is no doubt that, in the long run, occlusion is the most important factor in the permanence of the restoration. This is, of course, well recognized and is today being brought to ever higher standards of perfection. In view of that fact, it is all the more surprising that so little attention has been paid to whether the forces transmitted to the abutment teeth by the prosthesis are the same as the normal occlusal force upon those teeth. A removable partial denture is no more permanent than its abutments, and if the function is altered, they will, correspondingly, be short lived. Although a proper occlusion upon the partial denture will undoubtedly postpone the time, they will eventually yield to pathologic force just as though they were in traumatic occlusion.

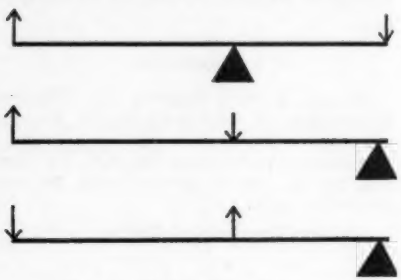

Fig. 1.—Basic classes of levers.

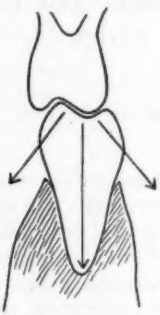

Fig. 2.—Diagrammatic representation of lines of force exerted on natural tooth in function.

The experience of a great number of competent observers from various schools of thought has shown that, over a long period of time, fixed bridgework has best served the primary function of conserving the supporting structures of the abutment teeth. The average fixed bridge is probably of poorer construction than the average removable appliance.

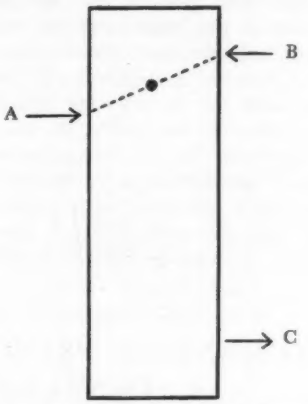

Fig. 3.—Forces exerted upon geometrical form if clasped as teeth usually are.

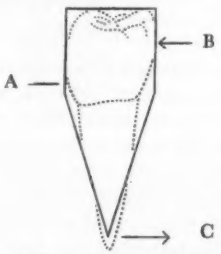

Fig. 4.—Tooth superimposed on geometrical form showing clasp leverage.

The occlusion of the average fixed bridge is probably no better than that of the average removable partial denture. At this point, I should like to make it clear that I am not trying to compare the virtues of fixed and removable restorations, for they cannot be compared. They are not interchangeable: each has its own place. Where indicated, the fixed bridge is always the restoration of choice. But when we cannot use fixed bridgework, the real problem is to determine what desirable properties it possesses that the removable piece lacks, in order to impart these properties to those restorations which must of necessity be removable.

Figure 1 is a typical diagram of the three classes of levers that are capable of transferring force. The lever of the first class has a fulcrum located between the applied force and the load or, as it is in our considerations, resistance to that force. Usually, although not necessarily, with a lever of this type, the applied force has a mechanical advantage. A lever of the second class has the load or resistance located between the force and the fulcrum, and the force always has a mechanical advantage. The lever of the third class has the applied force between the fulcrum and load, and the load always has the mechanical advantage. It is important that we recognize the variations of these three basic forms, as they are the basis of all partial denture construction regardless of what system we may follow.

Figure 2 is a diagrammatic representation of the lines of force exerted on a

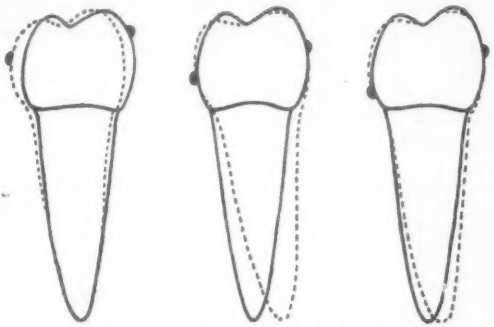

Fig. 5.—Forces exerted upon abutment tooth when clasp appliance is seated.

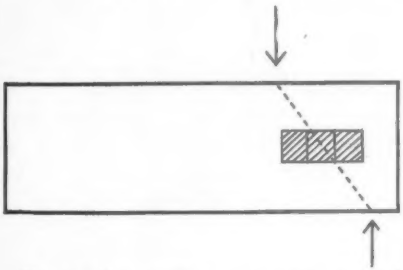

Fig. 6.—Key inserted to prevent torsional movement.

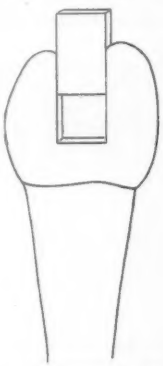

Fig. 7.—Keyway in tooth.

natural tooth in function. The force is always torsional, and the actual direction and amount of force will of course vary with the shape and occlusion of the tooth, but, in general, it will resolve itself into this type of force. The stress is applied at the occlusal surface and is transmitted at right angles to the inclined plane. The apex of the tooth is the fulcrum and the supporting bone is the resistance or load. The tooth therefore always functions as a lever of the second class. The form of the supporting bone proves this. In a lever of the second class, the nearer the load approaches the fulcrum, the greater the mechanical advantage; or, conversely, the nearer the fulcrum, the greater the resistance required to prevent movement of the lever. The nearer we approach the apex of the tooth, the greater the cross-sectional thickness of the bone provided to resist the force applied on the cusp, so that the amount of pressure absorbed by all the bone

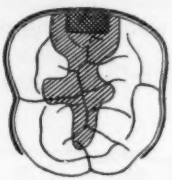

Fig. 8.—Gillett clasp, showing rest retained by clasp.

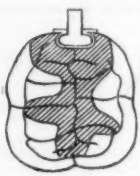

Fig. 9.—Precision attachment, showing rest retained by inlay.

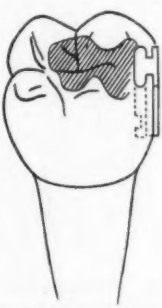

Fig. 10.—Precision attachment with recess for replaceable tension plate.

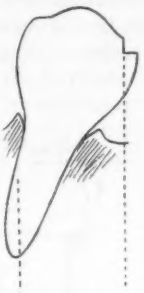

Fig. 11.—Tipping force of occlusal rest. Mechanical advantage of force depends upon distance between dotted lines.

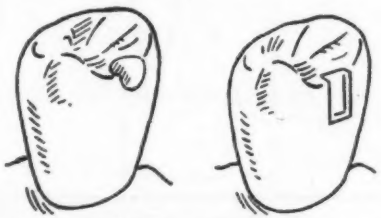

Fig. 12.—Simple forms of occlusal rest, showing lack of dovetail.

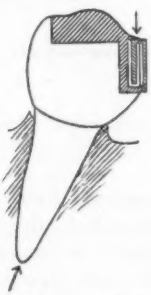

Fig. 13.—Showing how precision attachment prevents tipping of tooth.

supporting the tooth is the same.

Because of the form and position of the teeth to be clasped, we usually cannot locate the arms of the clasp opposite each other without springing the tooth out of position whenever the case is seated, with early loss of the abutment. Suppose, as in Figure 3, we took any geometrical object and exerted force by means of levers at points A and B. It would tend to rotate in the direction of arrow C, around a point which lies on a line drawn from A to B. Force A creates a lever of the first class with its fulcrum at B. Force B creates a lever of the third class with its fulcrum at A. At no time is there a lever of the second class. Changing the form of the object, as in Figure 4, does not alter the case, and superimposing a tooth upon it gives us a representation of the original clasp survey line. Therefore, the clasp has converted the tooth to a combination lever of the first and third classes; whereas nature designed it for a lever of the second class.

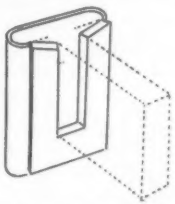

Fig. 14.—Absence of proximal contact sometimes allowing box to become distorted and spoiling accuracy of precision fit.

Fig. 15.—Cross section of Fig. 14. Spreading of box made it necessary to keep opening the attachment and resulted in wedging and breakage instead of sliding fit.

We know that the clasp must go over the tooth at its largest diameter in order to retain the appliance. When the case is seated, therefore, the tooth must tend to go through the movements shown in Figure 5. The question as to which actually gives, the arm of the clasp or the tooth, or both, depends, of course, on their relative resistance. If we assume that the tooth is firm and healthy, and the clasp light and springy, when it is in position we shall have static equilibrium. But that means constant pressure, and bone is the most plastic tissue in the body. It most readily yields to permanent deformation, and there is little doubt that, under the constant pressure of a clasp, it will yield, either by bending or pressure atrophy, depending on the amount of pressure. That, in turn, alters the occlusal relationship and results in traumatic occlusion, particularly if any attempt is made to adjust the clasp at a subsequent time. If the clasp does not press against the tooth, it will not produce friction, and, without friction, it will not function.

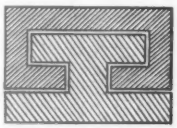

Fig. 16.—Addition of proximal contact plate making spreading of box impossible.

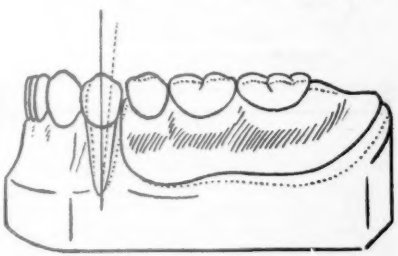

Fig. 17.—Torsion on abutment tooth rigidly connected to saddle.

We have all seen cases with very large

saddle areas which function without clasp friction, but that is not the case with most of the restorations being turned out in such large quantities by commercial laboratories today. The argument has been put forth that clasp friction does not do a great deal of harm, and of itself that is true. More important is the fact that this is but one of several forces being brought to bear simultaneously, all of which taken together become of material consequence.

Returning to the geometrical figure: we could prevent rotation by inserting a key attached to some external point on the levers A and B, as in Figure 6. In a tooth, we could accomplish the same thing by means of a sliding key, as in Figure 7, provided the walls of the keyway were parallel and made sufficient contact with an accurate fitting key before the arms of the clasp contacted the tooth. This, of course, is the principle of the Gillett clasp. Seen in cross-section (Fig. 8), it is fundamentally a deep-seated, straight-sided rest, maintained in position on the tooth by means of the clasp arms. Pressure from the bridge to the abutment tooth is transmitted by the rest instead of the clasp arms, and this prevents torsion by the clasp on the tooth. Because of the manner in which it has in the past been constructed, the rest had to be large and heavy to be effective, and it was extremely difficult to maintain parallelism. With the preformed precision rests now available, construction is much easier.

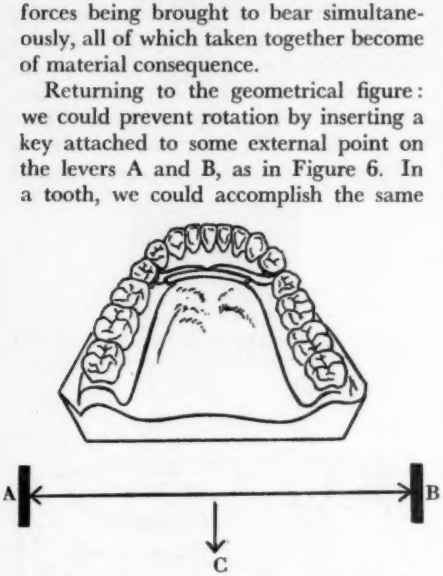

Fig. 18.—Common type of wire stress-breaker. Pressure on prosthesis causes abutments to be drawn toward each other.

This is essentially the principle of operation of the modern precision attachment. As seen in cross-section in Figure 9, it consists of a deep-seated precision rest maintained in position by internal friction rather than external frictional clasp arms. Numerous methods have been employed to produce this friction, but the most popular types in use today have a recess cut in the male portion which holds an easily replaceable tension plate to overcome wear. One of these is shown in Figure 10.

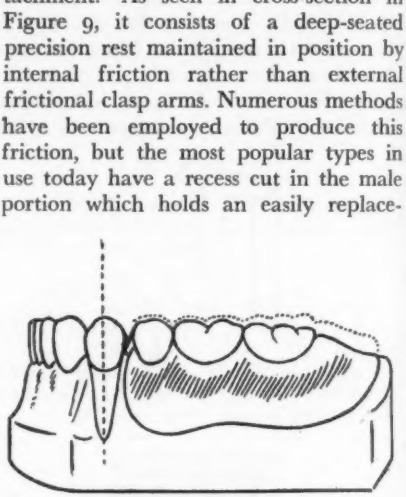

Fig. 19.—Simple hinge stress-breaker preventing torsion on abutment but still transmits vertical pressure to tooth.

The next force with which we have to deal is the tipping caused by the occlusal rest. (Fig. 11.) The mechanical advantage of this force depends on the horizontal distance between the apex and a vertical line through the rest. The greater the tilt of the tooth, the greater the force with the same load. It is obvious that the simple rest usually employed (Fig. 12) would not tend to resist this force; nor would the Gillett clasp, unless it were dovetailed. But, as in Figure 13, the precision attachment does prevent this tipping; for, as the tooth

tends to tip under mastication, the thrust of the occlusal end of the male portion forces the tooth to maintain its position.

There is no doubt that this tipping force does exist as a powerful force, for, as shown in Figure 14, it was a source of considerable trouble to early precision attachment workers. It was a common experience to have the tipping force, which tends to carry the bottom of the male section of the attachment away from the tooth, cause the box to bend, and thus lose the frictional engagement and cause the appliance to wedge. It produced the effect seen in cross-section in Figure 15. This has been overcome by the addition of the proximal contact plate. (Fig. 16.) If the clearance between the contact plate of the male and

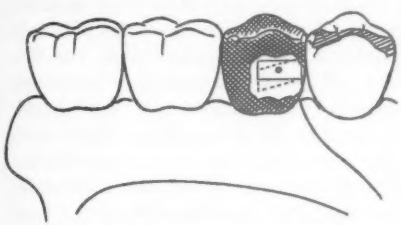

Fig. 20.—McCollum stress-breaker.

the reinforcing plate of the female portion is less than the clearance between tube and head, the contact plate will always force the box to maintain its form and fit. The contact plate also increases the frictional surface.

Now we come to the third type of stress, which the distal extension partial denture can bring to bear upon the parodontium. It has been amply demonstrated that all tissues are displaceable in varying degrees. If, as in Figure 17, the saddle is rigidly attached to the abutment tooth, when in function the mesial end of the saddle cannot be depressed without forcing the tooth down in its socket. While this can occur if one tooth is carrying too great a share of the occlusal area, in most cases it does not happen directly. It will eventually take place as a result of the loosening caused by other factors. Since the distal end of the saddle is supported only by soft tissue, if the attachment is rigid, there will be a tendency to rotate the abutment tooth in an arc with its apex as a center. Since the tooth in proportion to the saddle is usually very short, the amount of movement is very small, but, by the same token, the saddle possesses an enormous mechanical advantage and it is impossible for the tooth to resist it.

Because the amount of movement of the tooth is very slight, this rotation would not take place with a clasp, since, regardless of how rigid a clasp itself might be, it will always possess ample latitude of movement on the tooth to permit movement of the saddle. It is

Fig. 21.—Cross section showing exaggerated relief of stress-breaker bar. Saddle can move only in one direction.

the rigidity of connection between the tooth and saddle, and not the rigidity of the retainer itself, which is the determining factor. Since a properly constructed attachment does connect rigidly saddle and abutment, compensation is essential or the constant torque will in time result in loss of the abutment. In most cases, the use of the conventional type of stress-breaker made of clasp wire will do far more harm than good. Nevertheless, countless numbers of distal extension attachment cases have failed for want of proper stress-breakers.

Figure 18 illustrates a common type of stress-breaker employed in lingual bar cases. The two clasps are connected by a piece of clasp wire, which, in turn, is connected with the center of the bar.

Directly below it is a diagram showing what happens in function. If we connect a piece of flexible wire to the points A and B, as we depress it at C the points A and B must be drawn toward each other. In a like manner, the abutments of a case with spring wire stress-breakers are drawn toward the point of attachment of the wire. This has introduced a new stress, which would not be present if it were not for the so-called stress-breaker. Meanwhile, the distal tilt of the tooth, which the stress-breaker was designed to relieve, continues, since to relieve that the wire would have to make a torsional twist, to which all wires possess great resistance. But, even worse, this type of stress-breaker allows vertical displacement of the saddle, resulting in shrinkage and loss of saddle support. Thus, we have created a constantly accelerating vicious circle which leads to premature loss and failure of the restoration.

But if, as in Figure 19, the saddle were attached to the abutment by means of a simple hinge, the entire result would be altered. The abutment tooth would still bear the occlusal stress upon the mesial end of the saddle, but this would be exerted as a normal vertical thrust upon the tooth. The mesial end of the saddle could not be depressed upon the tissue. The distal end of the saddle could still be depressed, but now it would rotate about the pin of the hinge instead of rotating the tooth. The load would be distributed between the soft tissue and the abutment, since this is a simple lever, and the proportion each would bear would depend on the point at which it was exerted. If the distal extension of the saddle were twice as great as the length of the occlusal area, since this is a lever of the second class, the tissue would have a mechanical advantage of 2:1. In other words, the tooth would bear two-thirds of the load and the tissue one-third. The closer the point of pressure approached the abutment, the greater the mechanical advantage of the tissue and the less stress it would be forced to take. How is this stress distributed over the tissue? As the case starts to function, stress is brought to bear upon the tissue at the distal end of the saddle. As this point starts to be depressed, the tissues mesially from it begin to come in contact and absorb part of the load. They possess a mechanical advantage over the tissues under the distal end of the saddle, and prevent excessive pressure at that point. It is obvious, then, that the larger the saddle, and the shorter the occlusion, the less the movement of the stress-breaker and the pressure upon the tissues.

Various attempts have been made to design stress-breakers upon this principle, notably the Dresch and Kayle, but they have all failed because they all permit vertical displacement of the saddle. While they do for a time relieve stress upon the tooth, they cause rapid absorption of the underlying tissue. Actually, the tooth does not bear any of the load, but merely serves to prevent the denture from becoming unseated when not in function. Eventually the occlusion is lost and the abutments are destroyed.

The only stress-breaker that will completely fill the requirements is the McCollum. This consists of a square bar attached to the retainer, and inserted in a square tube contained in the bridge tooth adjoining the abutment. There are various methods of making it operate. The method that I have found best is shown in cross-section in Figure 21. An axle passes through the bar and two sides of the tube. The side of the bar facing the occlusion is relieved distally from the axle, and the opposite side mesially from it. That means that, in function, the stress-breaker can rotate around the axle as a hinge, but it can-

not lift itself from contact with the tissues when not in function. For purpose of illustration, the amount of relief has been greatly exaggerated. In actual practice, the saddle is such a long arm in comparison to the length of the stress-breaker bar that the amount of relief and of motion is hardly discernible. The amount of movement is completely within the control of the operator, depending entirely on the amount that the bar is relieved.

This is essentially a simple hinge, except that the amount of opening is entirely under control, and completely relieves the torsional stress upon the tooth. It does not remove the stress from the tooth and place it upon the saddle area, but it alters the direction of that stress to the normal function of the tooth.

Most of us have been under the impression that the precision attachment is of comparatively recent origin; at least, within the memory of men who are practicing today. I have a slide showing a precision attachment in use about 100 years ago. The resemblance to modern attachments is remarkable. I have twenty slides showing the development and the various systems for use of attachments over a period of about sixty years, until the advent of the Bonwill clasp. The clasp came into use about the same time that the dental mechanic began to take an important place in dental practice, and it is important to note that the development of the clasp has paralleled the growth of the dental laboratory. Fortunately, dentists are beginning to see the morass into which they have allowed themselves to be led, and are, in increasing numbers, turning back to the single thing in restorative dental practice which has stood the test of time—the precision attachment.

CONCLUSION

The indiscriminate use of clasps has exerted forces upon the natural teeth that have led to the premature loss of teeth which could, by the use of proper retainers, have given many years of healthful service. The progressive loss of abutments has eventually caused the loss of many teeth, resulting in the necessity of resorting to full dentures, with their attendant disadvantages. By the use of precision attachments, it is possible to transmit the normal, physiologic forces from a removable partial denture to the natural abutment teeth; which results in the preservation of these teeth and conserves the mouth as a healthy functioning unit.

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POSSIBLE DIMENSIONAL CHANGES IN DENTURE BASE MATERIALS

By W. R. KERN,* D.D.S., M.S.D., Chicago, Ill.

IT IS common knowledge that plastic denture base materials do not duplicate with absolute accuracy the wax model of which the finished denture is the final product, but it may not be so generally known that these materials may fail in a greater or less degree to keep their shape once the denture has been completed. The cellulose denture materials used years ago are the most striking examples of materials exhibiting the latter defect, and there are other materials of more recent use that fail to a considerable extent to hold their shape after fabrication of the article.

Probably all materials used as bases for artificial dentures, the metals and porcelain excepted, are more or less unstable in that they tend to warp or change shape, to some extent, in the mouth, and it was for the purpose of studying the nature and magnitude of dimensional changes which may occur after completion of the denture that this investigation was conducted. Changes occurring during pressing, curing or processing have been recorded, but our principal concern has been with those changes taking place after the denture has been completed.

Sweeney[1] has given a report on this subject, and it was thought that further work along the same line would be of interest and value, particularly since a different method has been employed. In Sweeney's work, complete dentures, both upper and lower, were worn by the patients during the period covered by the investigation. In the present study, complete dentures were not used for several reasons: the difficulty of making accurately the desired measurements, the cost of the materials for making a large number of dentures and the belief that specimens or models representing a cross-section of an upper denture in the molar region would serve satisfactorily. Although the results obtained by using these models might be slightly different from those of using complete dentures, it was thought that changes in these models would be comparable to those in complete dentures and the results obtained do seem to compare favorably with those previously reported.[1]

Although no photo-elastic studies are presented, it is assumed that any change in shape of the denture after curing will be the result of (1) the release of strains or (2) a definite plastic deformation brought about by mouth forces. The latter point has been ruled out of consideration in the present study since the specimens were not at any time subjected to stress other than that caused by gravity. In order to exaggerate the first consideration, only the posterior portion of a denture base was used. Obviously, the results are of clinical value only in comparing the release of strain or warpage of the various denture base materials and any uniform expansion caused by the absorption of moisture.

MATERIALS

Six denture base materials were em-

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ployed that were in common use at the time these experiments were conducted:

Crystolex (pink, powder-liquid), Detroit Dental Mfg. Co.

Exelon (blank), Exelon Mfg. Div.

Luxene 44 (cake), Bakelite Dental Products.

Vernonite (pink, cake), Vernon-Benshoff Co.

Vernonite (transparent, cake), Vernon-Benshoff Co.

Ash's olive base rubber, Claudius Ash's Sons.

This group represents three acrylic resins or, more strictly speaking, two, as the pink and transparent Vernonite may be considered as one material; two vinyl-acrylics, and one vulcanite.

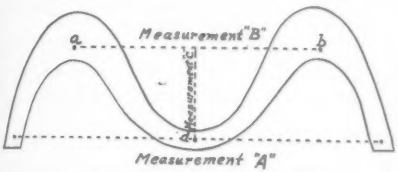

Fig. 1.—Specimen and measurements.

DIMENSIONAL CHANGES OCCURRING DURING PROCESSING AND OVER PERIOD OF TWENTY-FOUR WEEKS AFTER PROCESSING

Measurement	Change During Processing			Change After Processing			Total Change		
	A	B	C	A	B	C	A	B	C
	Per Cent			Per Cent			Per Cent		
Crystolex	−0.32	−0.33	−0.22	+0.24	+0.32	−0.10	−0.08	−0.01	−0.32
Exelon	−0.12	+0.17	−1.06	+0.19	+0.08	+0.94	+0.07	+0.26	−0.13
Luxene 44	−0.44	−0.24	−0.83	−0.04	+0.01	−0.01	−0.48	−0.23	−0.84
Vernonite Tr.	−0.54	−0.43	−0.58	+0.15	+0.22	+0.03	−0.39	−0.22	−0.55
Vernonite P.	−0.37	−0.44	−0.58	+0.19	+0.23	−0.49	−0.20	−0.22	−1.08
Vulcanite	+0.15	−0.10	−0.92	−0.21	−0.04	−0.40	−0.05	−0.13	−1.31

PROCEDURE

A section from left to right was cut from the molar region of a metal cast representing an upper edentulous arch of average size and depth of vault. Upon this section of metal cast, wax models of uniform dimensions were constructed representing cross-sections of an upper artificial denture, except that they contained no teeth. In these wax models, small depressions or points of reference were made, by means of which the measurements were secured (Fig. 1). Three measurements, designated hereafter A, B and C, were taken. A is the distance from one buccal flange to the one on the opposite side. B is the distance from the crest of the ridge on the right to the crest of the ridge on the left. C is the depth of the vault. All wax models were tinfoiled before being flasked, except those used for rubber. All were flasked in model plaster and upon casts made of hydrocal. Conditions of flasking were kept as nearly uniform as it was possible to keep them, and the manufacturers' directions for processing were followed. Five trials were made with each material.

Upon the removal of each specimen from the flask, measurements A, B and C were taken and the change in these dimensions during processing noted, with the results shown in the accompanying table. The specimen was then placed in water at body temperature and measured at intervals of six weeks over a period of six months. Two of the materials were measured each week during the first six weeks and every six weeks thereafter.

For making all measurements, a microscope comparator was used, by means of which very accurate measurements could be secured. A and B were made by measuring directly across from one

point of reference to the other, but C was not quite so simple. To secure C, a cellulose cement was stretched into a filament and placed across the specimen from a to b (Fig. 1) and a measurement made from d to the cement filament along a line that would form a right angle with the filament. The making of each C measurement necessitated the placing of a new filament; and, because of the obvious difficulty of placing the filament in precisely the same place each time, C is probably less accurate than the two other measurements. A and B may be considered accurate to within 0.01 per cent, and measurement C to within approximately 0.24 per cent.

In the table and charts presented here, "change during processing" is the change occurring between measurements taken on the wax patterns immediately before investment and those taken on the specimens immediately after processing and removal from the flask. In the Table and Figures 8, 9 and 10, "change after processing" was determined by averaging the measurements taken at the end of each of the four six-week periods. "Total change" is the sum of these two dimensional changes.

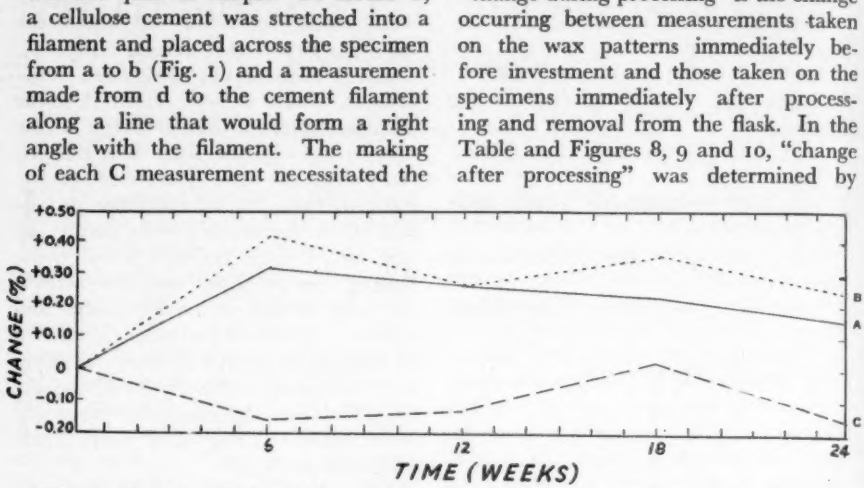

Fig. 2.—Crystolex; change after processing. (In Figures 2-7, measurement A is represented by the solid line, B by the dotted line and C by the broken line.)

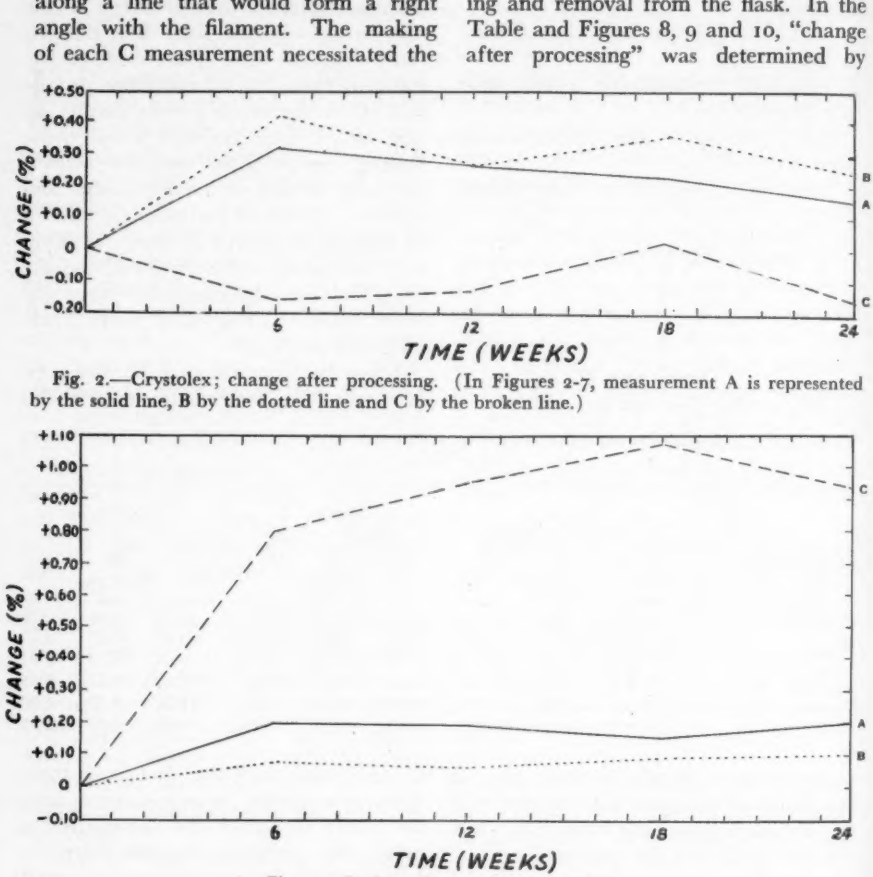

Fig. 3.—Exelon; change after processing.

CHANGE IN SHAPE DURING PROCESSING

It has been shown by other investigators[1, 2, 3] that the materials under

consideration, with the possible exception of the thermoplastic material, exhibit a volume contraction during processing. With an object of irregular shape such as a denture, it is a problem to determine how contraction during processing and any change after processing may affect the shape. It was concluded that the changes which would probably be the greatest, those which could be most conveniently measured and those which would be the most likely to affect the fit of a denture to the greatest degree, could be shown by making the three measurements as before described.

A study of the Table will reveal the following general results: vulcanite exhibited a slight expansion in measurement A and the thermoplastic material in B. The other measurements of these two materials and all measurements of the other materials indicated contraction. With the exception of one of the acrylics, all materials showed a greater contraction in measurement C than in the two other measurements. The greatest amount of contraction in the vault (C measurement) was exhibited by Exelon, vulcanite and Luxene 44, in the order named; and the least, by the acrylics.

CHANGE IN SHAPE AFTER PROCESSING

None of the materials remained constant after processing. Luxene 44 exhibited very little change. All of the others showed changes of greater or less magnitude in each of the three dimensions measured. In general, the greatest change occurred during the first six weeks.

In five trials with Luxene 44, the A measurements were very close together and, when averaged, showed only a very slight contraction (0.04 per cent). The B measurements of the different trials were also very close together and averaged no significant change (+0.01 per

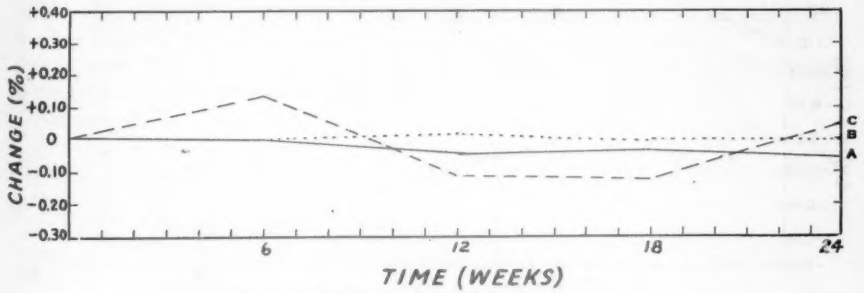

Fig. 4.—Luxene 44; change after processing.

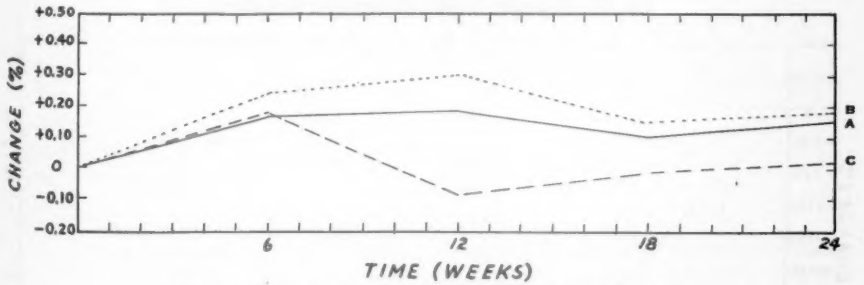

Fig. 5.—Vernonite (transparent); change after processing.

cent). As with all of the materials tested, the C measurements of the different trials were rather widely divergent, but the divergence was uniform and the average indicated almost no change (−0.01 per cent).

The acrylic resins showed an expansion of from 0.15 per cent to 0.24 per cent in the A measurement and from 0.22 per cent to 0.32 per cent in the B. In measurement C, Crystolex showed a contraction of 0.10 per cent, Vernonite pink a contraction of 0.49 per cent and Vernonite clear a very small expansion (0.03 per cent). The reason for the difference in the average C measurements of the pink and clear material is not known.

Exelon, the only material that exhibited an appreciable expansion in C measurement, showed an expansion of 0.19 per cent in A, 0.08 per cent in B, and 0.94 in C.

Unlike the other materials, vulcanite exhibited a contraction in all three measurements.

The question arises as to whether the apparent expansion or contraction of the different measurements or dimensions of the specimens indicates an expansion, a contraction or a warpage of the object. It would seem that these changes that

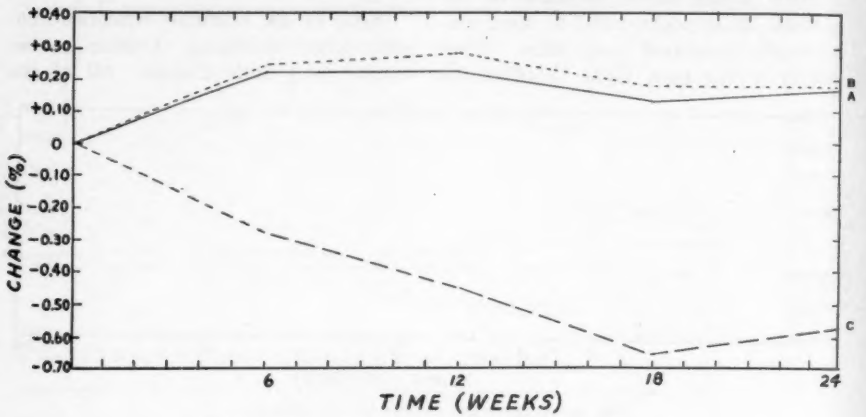

Fig. 6.—Vernonite (pink); change after processing.

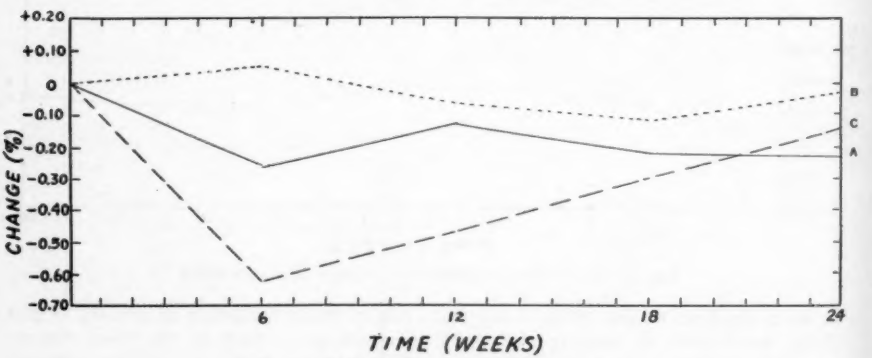

Fig. 7.—Vulcanite; change after processing.

take place after processing are probably due to both expansion and warpage. All of the materials absorb moisture to some extent, and it has been demonstrated by Gieler and Skinner[4] that at least four of them expand because of the absorption of water. That the release over a period of time of stresses within the material would tend to warp the object seems highly probable and is substantiated by a lack of uniformity in the measurements of the different specimens of the same material. This lack of uniformity may be explained by the fact that stresses that would tend to warp the material would not necessarily always act in the same direction.

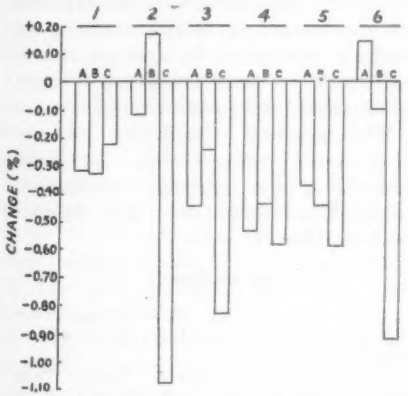

Fig. 8.—Comparison of various materials as to dimensional changes which occurred during processing. 1. Crystolex. 2. Exelon. 3. Luxene 44. 4. Vernonite, clear. 5. Vernonite, pink. 6. Vulcanite.

contracts rather than expands in the presence of moisture, since all three measurements indicate a contraction. These findings tend to substantiate the work of Sweeney,[1] who reports on two vulcanite dentures, an upper and a lower, on each of which a measurement taken across the posterior area (corresponding to my measurement B) showed a contraction after six and seven months in service. At the end of fifteen months in service, the lower indicated a still greater contraction although the upper indicated a slight expansion. The present findings in regard to the behavior of

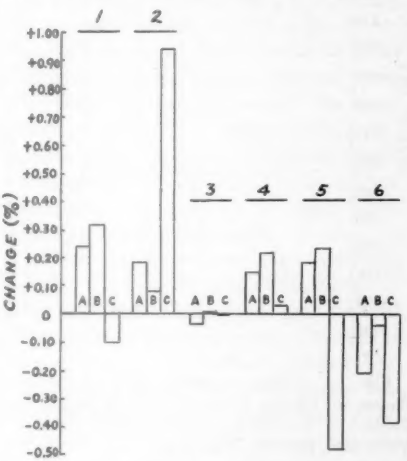

Fig. 9.—Changes after processing averaged over a period of twenty-four weeks. 1. Crystolex. 2. Exelon. 3. Luxene 44. 4. Vernonite, clear. 5. Vernonite, pink. 6. Vulcanite.

A study of the Table and of Figure 9 will reveal that the action of vulcanite after curing and in the presence of moisture apparently differs from that of the other materials tested. Most substances expand on absorption of moisture, and it was expected that this would hold true of the materials concerned in this investigation, and in fact such seems to be the case, except of vulcanite. According to the results obtained, vulcanite Vernonite in the presence of moisture also agree with his.

Any dimensional changes which may occur in a denture either during or after processing will obviously affect its fit or adaptation. It is not within the scope of this paper to discuss the practical significance of the changes noted herein, but further study of a clinical nature would be of value in determining their practical import.

SUMMARY

In tests of denture base materials representing three groups, acrylic, vinyl acrylic and vulcanite, all materials showed dimensional changes during processing. The tests were made on models that represented a cross-section of an upper denture in the molar region. The changes indicate a general contraction and range from +0.17 per cent to −0.44 per cent by measurement from left to right across the model and from −0.22 per cent to −1.06 per cent in depth of vault.

Under conditions of moisture and temperature simulating those of the mouth, all materials showed dimensional changes ranging from +0.32 per cent to −0.04 per cent by measurement from left to right and from +0.94 per cent to −0.49 per cent in depth of vault by measurements averaged over a period of twenty-four weeks after processing. Changes after processing indicate a general expansion of all materials except vulcanite, which showed contraction. Luxene 44 appeared the most stable material after processing, showing little change, but showing a slightly greater change than some of the other materials during processing.

That the dimensional changes which occur after processing may be influenced by the release of strains resulting in warpage is indicated by a certain lack of uniformity in the behavior of different specimens of the same material.

The practical significance of the above-noted changes has not been studied in the present investigation. Their effects should be noted through clinical observation.

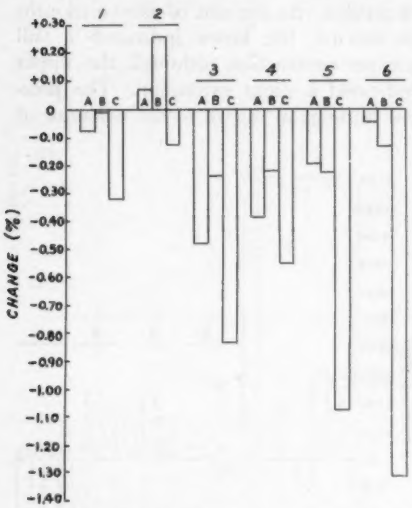

Fig. 10.—Total change: sum of results shown in Figures 8 and 9. 1. Crystolex. 2. Exelon. 3. Luxene 44. 4. Vernonite, clear. 5. Vernonite, pink. 6. Vulcanite.

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VARIABILITY OF DIAGNOSES OF INCIDENCE OF DENTAL CARIES

By Dorothea F. Radusch,* D.D.S., A.B., M.S., Minneapolis, Minn.

REPORTS comparing data of two or more series of examinations for the incidence of dental caries are constantly appearing in the literature. Yet, except in a few instances, there has been little recognition on the part of the authors of such reports as to the possible variability of the examiners as an important factor in the apparent results of their studies; and this in spite of the fact that the significance of the rôle of the judgment of the examiner has been well recognized in allied scientific fields and emphasized in books on statistical interpretation. (Gibbs; Treloar.)

Variability of routine diagnoses of dental defects was considered by Deatherage, Wilson and Ledgerwood (1936), with startling results. Their figures show beyond question that it is essential to know the margin of diagnostic variation of even presumably equally competent dentists, in order "to determine the magnitude of reported differences which may be regarded as significant of anything more than discrepant diagnosis."

Satisfactory uniformity among examiners must be established or suitable corrections be made for variability; otherwise, comparisons between groups are of unknown and doubtful validity. Some examiners exhibit a constant tendency to report a greater or lesser number of carious teeth; other numbers are sometimes high and sometimes low, so that the variation will be canceled over a series of cases. An attempt was made to equalize the effects of this variation of examiners in the study by Dean and his associates (1939) by having each of the two dentists examine approximately an equal number of children in each school.

It is difficult for the individual dentist and research worker to realize the extent of variability possible even with the most conscientious examiners. Personal participation in a survey in which the same group of subjects is independently examined by several examiners is an excellent means of recognizing that confidence in statistics not properly guarded from such error may be misplaced.

To test this hypothesis, eight dentists, all of whom had years of clinical experience and who were considered careful investigators, examined a group of thirty-three college women. Each subject was given independent, but consecutive examinations by each of three examiners. The same mouth mirror and sharp explorer were used by each examiner, while the patient remained seated in the same dental chair, thereby keeping the conditions for the three examinations similar. No time limit was set for the examination, although it was to be made without undue delay. No examiner had any knowledge of the results of the other examinations, but knew that his findings would be checked against those of the other two, and consequently was especially careful.

Surfaces were computed according to the modified dental caries index of Bodecker (1939), using two surfaces for

*Chairman, Minneapolis Caries Study Group.

occlusal maxillary molars and mandibular premolars, the lingual surfaces of the first and second maxillary molars and buccal surfaces of mandibular molars.

The findings as given in Tables 1 and 2 show the extreme variability possible. were reported as to the number of carious surfaces in each case. The average difference between the highest and lowest estimates of all cases was 5.8 carious surfaces and 4.2 carious teeth. The mean difference in three series of nine cases

TABLE 1.—NUMBER OF CARIOUS TEETH IN EACH CASE AS REPORTED BY EXAMINERS

Case	Examiners								D*
	1	2	3	4	5	6	7	8	
1	14	10	11						4
2			5		9	9			4
3	11	4					7		7
4	8						14	7	7
5			6				4	5	2
6	12		4					5	8
7	6		5					4	2
8			4				8	6	4
9		1		2				0	2
10	5		6			4			2
11	3							1	2
12	8	6	4						4
13	12	7	11						5
14	14	8	6						8
15	14		11				11		3
16	8	4						2	6
17		2	2					4	2
18	9						12	10	3
19		14					15	10	5
20				1	1			1	0
21			5			6	7		2
22			3			1	8		7
23		4	1		1				3
24				9	9			10	1
25			5			6	13		8
26	10	5			6				5
27	8	3						2	6
28	8				6			7	2
29			1		1			2	1
30	12	12	5						7
31		4	3				9		6
32		2	0		7				7
33	5		5					2	3

*Difference between highest and lowest number reported. Average difference: 4.2 carious teeth.

TABLE 2.—NUMBER OF CARIOUS SURFACES IN EACH CASE AS REPORTED BY EXAMINERS

Case	Examiner								D*
	1	2	3	4	5	6	7	8	
1	23	15	14						9
2			7		11	11			4
3	13		5				7		8
4		9					20	8	12
5			9				9	9	0
6	14		4					5	10
7	7		5					4	3
8			4				9	7	5
9		2		2				0	2
10	9		7			4			5
11	3							1	2
12	11	7	6						5
13	16	8	12						8
14	21	12	8						13
15	17		11				13		6
16	9	4						2	7
17		4	3					5	2
18	11						15	12	4
19		21					21	15	6
20				2	1			2	1
21			6			7	10		4
22			3			1	10		9
23		4	1		1				3
24				9	13			12	4
25			5			7	19		14
26	15	9			8				7
27	8	3						2	6
28	14				7			9	7
29			1		1			2	1
30	13	12	5						8
31		4	3				9		6
32		2	0		8				8
33	5		5					2	3

*Difference between highest and lowest number reported. Average difference: 5.8 carious surfaces.

For example, in Case 3, the number of carious teeth was reported as eleven, four and seven; while in Case 14, it was six, fourteen and eight. In one-fourth of the cases, the difference between the lowest and the highest number of carious teeth was seven or eight. Similar discrepancies each reported by examiner 1 and 2 was 4.3 carious teeth and 6.0 carious surfaces; examiners 1 and 3 was 3.8 carious teeth and 6.6 carious surfaces, and examiners 2 and 3 was 1.2 carious teeth and 1.7 carious surfaces.

It may be thought by some that if

more cases had been examined, differences in diagnosis might have been balanced. This seems hardly possible when one studies individual records, for these show that many examiners as compared to a colleague have a tendency to be consistent in understating or overstating the dental condition. Examiner 1 reported more carious surfaces than either of the two others in sixteen of seventeen cases that he examined. Examiner 3 was lowest in fourteen of twenty-two examinations.

These results suggest the unreliability of comparisons of two sets of data made by different examiners regardless of the interval, be it minutes, months or years, without proper correction for diagnostic variability. If the first data had been compiled from examinations by some one consistently high, as was Examiner 1, and the later data by one consistently low, as was Examiner 3, findings would indicate substantial changes in the incidence of decay which would not be actual.

Bitewing roentgenograms of all the patients were examined for proximal cavities by seven of the original eight examiners, with the average number of such cavities designated by each as 5.1, 6.3, 6.6, 6.7, 7.1 and 7.9. The difference between the highest and lowest estimate was 2.8 cavities.

Examiner 1, who consistently designated the most cavities clinically, found 6.6 by roentgenographic examination; while Examiner 3, who was lowest clinically, found 6.3. Both, previously at the extremes, were now midway. This shift in results is significant. Are standards for judging evidence of caries in roentgenograms more definitely established than clinical standards?

The results of this study were so striking that their publication may help to emphasize the importance of a test or correction in all surveys before findings can be accepted as to the dental condition. Further data relative to the variability of the individual examiner when reexamining the same dental subjects would be valuable, since research in allied fields indicates that examiners vary widely in their standards from time to time. It is not improbable that many of the seemingly conflicting results of dental research may be due to these diagnostic variations.

D. R. Clark, J. T. Cohen, H. S. Eberhardt, R. L. Hedburg, B. M. Medof, H. W. Reinking, and A. E. Westling assisted in collecting and organizing the data. Eva Donelson of the University of Minnesota obtained the subjects for the examinations.

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ANTIBACTERIAL ACTION OF HUMAN WHOLE BLOOD UPON BACTERIA ISOLATED FROM PERIAPICAL TISSUE*

By I. B. Bender, D.D.S., and G. C. Tassman, D.D.S., Philadelphia, Pa.

Heist and Solis-Cohen[1] were the first to show that whole blood possesses antibacterial action *in vitro*. Since then, various investigators have reported the action of human whole blood *in vitro* on the meningococcus,[2] gonococcus,[3] pneumococcus[4] and *Streptococcus hemolyticus*.[5] As far as we know, however, the action of human whole blood on the bacteria isolated from the periapical area has not been studied. We are, therefore, presenting the findings obtained in investigating this subject.

METHOD† AND MATERIAL

Bacteria were obtained by direct approach[6] or *via* the root canal from infected periapical tissue presenting definite roentgenographic evidence of rarefaction. The culture used for the direct approach was made by introducing a sterile loop directly into the surgically exposed infected root and inoculating 6 cc. of sterile hormone broth. If the root canal approach was used, the canal was flushed with sterile water for three minutes. A sterile paper point was inserted without pressure as far as it would go. The point was allowed to remain in the canal for one minute and then dropped into a tube of hormone broth. The sample was then cultured for twenty-four hours at 37°C. Bacterial suspensions were diluted in a graduated range from the undiluted to a concentration of 1:10,000,000. Sterile glass tubing plugged with cotton at both ends was introduced into the flame and capillary pipets were drawn out and sealed at one end.

A mark was made on the pipet with a paraffin pencil. The sealed end of the pipet was then broken off with sterile gauze and sterile hormone broth was drawn up to the mark and then expelled into another capillary pipet *via* the cotton plug. The undiluted bacterial culture was then drawn up to the same level with the marked pipet and expelled into the pipet holding the sterile hormone broth. Equal parts of bacterial suspension and hormone broth were thus obtained. This was then sealed in a flame at the plugged end and shaken vigorously for from three to five minutes to insure mixing. This procedure was repeated for all dilutions.

A sample of blood was then procured under sterile precautions from the patient harboring the infection (involved tooth), by pricking the finger. Needle puncture was found expedient for two reasons: It eliminated the need of a venous puncture and prevented any anticoagulant from interfering with the results. The first drop of blood was wiped off to get rid of serum, and firm pressure was then applied to the pricked

*From the dental and laboratory divisions of the Jewish Hospital.

Read before a joint meeting of the Philadelphia County Dental and Medical societies, February 21, 1941.

†Technic suggested by J. L. T. Appleton, Jr., a modification of the method of Heist and Solis-Cohen.

area. The blood was sucked up into the capillary pipet to the pencil mark, and the foregoing procedure was repeated, substituting whole blood for the sterile hormone broth in all the dilutions.

Two sets of control patients were selected: Group A, free of any periapical or sinus infection (checked with roentgenograms); Group B, those harboring periapical infection. Blood was obtained from the controls in the same fashion as from the subjects that were tested. This was repeated for each dilution. The pipets were sealed in a flame, shaken vigorously for three minutes to insure mixing and allowed to incubate for twenty-four hours at 37°C. After twenty-four hours, the tip of the pipet was broken off, and the contents were expelled and spread over the surfaces of blood-agar plates, which were allowed to incubate for another twenty-four hours and results recorded.

In order to avoid excessive pricking of the finger, and since each dilution required a fresh sample of blood, preliminary tests were performed to determine the lowest dilution at which blood would exemplify bactericidal action with this method. The patients were divided into odd and even groups, odd and even dilutions being used for the respective groups: odd groups dilution $10,^{-1}$ $10,^{-3}$ 10^{-5} and 10^{-7}; even groups, undiluted, $10,^{-2}$ 10^{-4} and $10.^{-6}$ It was found that dilution 1:10,000, or $10,^{-4}$ was the lowest dilution at which no growth was found in some instances. The dilution 10^{-3} was positive in all tests. The 10^{-3} concentration was then used as the starting point, thus eliminating the needless sticking.

TABLE 1.—GROUP A: CONTROLS HAVING NO PERIAPICAL INVOLVEMENT

	Dilutions						Dilutions					
	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}		10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	
Case 1	+	+	+	+	0	Hormone broth	+	+	+	+	+	Case 6
Control A	+	+	0	0	0	Control's blood	+	+	+	+	+	Control B
Str. viridans	+	0	0	0	0	Subject's blood	+	+	+	+	+	Staph. albus
Case 2	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 7
Control A	+	+	+	+	+	Control's blood	+	+	0	0	0	Control C
Str. viridans	+	+	0	0	0	Subject's blood	+	+	0	0	0	Pneumococcus
Case 3	+	+	+	+	+	Hormone broth	+	+	+	+	0	Case 8
Control A	+	+	+	+	+	Control's blood	+	+	0	0	0	Control C
Str. viridans	+	+	+	+	+	Subject's blood	+	0	0	0	0	Str. viridans
Case 4	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 9
Control B	+	+	+	0	0	Control's blood	+	+	+	0	0	Control C
Str. viridans	+	+	0	0	0	Subject's blood	+	+	0	0	0	Non-hemolytic streptococcus
Case 5	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 10
Control B	+	+	0	0	0	Control's blood	+	+	+	0	0	Control C
Str. viridans	+	+	0	0	0	Subject's blood	+	0	0	0	0	Str. viridans

+, presence of growth on blood-agar plate. 0, absence of growth on blood-agar plate.

RESULTS

Twenty-six cases were studied, in two of which the periapical tissue was found sterile despite large granulomatous areas.[7] Of the twenty-four cases remaining, ten were studied with controls free of infection (Table 1). Only three con-

trols were used in the first group so that the effect of the control blood could be discerned on the different strains of organisms. Of the first group, eight out of ten cases, or 80 per cent, showed bactericidal action of whole blood on bacteria isolated from the periapical area. Six out of ten cases, or 60 per cent, showed a higher bactericidal effect on the subject harboring the infection, suggesting the possible presence of antibodies.

Table 2 lists the fourteen cases remaining, with controls harboring infection. In six cases, the subject showed a higher bactericidal action than the control; while, in five other cases, the killing power was the same between subject and control. This may be attributed to the fact that some of the controls may have developed antibodies for the same strain, thus possessing the same killing power as the subject.

Case 15 demonstrates an interesting finding. Here, the control blood has a higher killing power than the subject.

The possibility that certain individuals possess a natural immunity against certain strains of bacteria might explain the findings; or it might be a contamination. To show that individuals develop a higher bacteriolytic titer in their own blood against their own organisms than against other strains, the control and subject were reversed; i.e., the subject of previous experiment was used as a control and the previous control as the subject. Cases 22 and 23 exhibit the action. Of the total of twenty-four cases, twenty-one, or 87 per cent, showed

TABLE 2.—GROUP B: CONTROLS HAVING PERIAPICAL INVOLVEMENT

	Dilutions						Dilutions					
	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}		10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	
Case 11	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 18
Control D	+	+	0	0	0	Control's blood	+	+	+	0	+	Control F
Str. viridans	+	0	0	0	0	Subject's blood	+	+	+	+	+	Pneumococcus
Case 12	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 19
Control D	+	+	0	0	0	Control's blood	+	+	0	0	0	Control F
Str. viridans	+	+	0	0	0	Subject's blood	+	+	0	0	0	Str. viridans
Case 13	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 20
Control D	+	+	+	+	+	Control's blood	+	+	+	0	0	Control G
Staph. albus	+	+	+	+	+	Subject's blood	+	+	0	0	0	Str. viridans
Case 14	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 21
Control E	+	0	0	0	0	Control's blood	+	0	0	0	0	Control H
Str. viridans	+	0	0	0	0	Subject's blood	+	0	0	0	0	M. catarrhalis
Case 15	+	+	+	+	+	Hormone blood	+	+	+	+	+	Case 22
Control E	+	0	0	0	0	Control's blood	+	+	0	0	0	Control I
Str. viridans	+	+	0	0	0	Subject's blood	+	0	0	0	0	Str. viridans
Case 16	+	+	+	+	+	Hormone blood	+	+	+	+	0	Case 23
Control E	+	+	0	0	0	Control's blood	+	+	0	0	0	Control J
Non-hemolytic streptococcus	+	+	0	0	+	Subject's blood	+	0	0	0	0	Str. viridans
Case 17	+	+	+	+	+	Hormone broth	+	+	+	+	+	Case 24
Control E	+	+	0	0	0	Control's blood	+	+	+	0	0	Control K
Str. viridans	+	0	0	0	0	Subject's blood	+	+	0	0	0	Pneumococcus

bactericidal action with this method.

In cases 1, 8 and 23, negative results were obtained in the hormone broth in 10^{-7} concentration. This is mainly due to the high dilution, because a small number of bacteria when transferred are probably unable to overcome the resistance of a large volume of liquid.[8] One must also consider that, with this method, such small amounts are used that it is possible to fail to transfer these organisms into the capillary pipet. The 10^{-7} dilution was primarily included so that the number of organisms could be counted by the plating method. The number of organisms varied from two to eight in the seventh dilution.

In order to show whether phagocytosis was present in these reactions, smears were made of six cases of various dilutions after twenty-four hours of incubation. These were stained with Wright's stain and fifty polymorphonuclear leukocytes were counted on each slide. There was no evidence of phagocytosis in either the positive or the negative cultures. In the positive cultures, the smears showed the bacteria to be extracellular. The absence of organisms suggested the presence of lysin.

COMMENT

From the evidence presented in the foregoing experiments, there was little doubt that whole blood was bactericidal for the organism found in the periapical area. It also demonstrated one of the hazards that bacteria must overcome to set up any secondary foci when they are dispersed into the blood stream from the periapical area. There was no evidence that the leukocytes are able to digest *in vitro* any of the organisms; which suggests that the bacteria are destroyed by means of lysis. This finding is at variance with that of Elliott[9] that polymorphonuclears remain actively phagocytic to *Streptococcus viridans* for at least twenty-four hours after the blood is added to a nutrient medium. Although the difference of one dilution is not a strong criterion for the presence of antibodies, it must be considered significant, since 50 per cent of the total cases demonstrated its presence.

Evidence also points to the difference in percentage of the two control groups. There was no marked evidence of the presence of possible antibody formation in the second group because control and subject more closely approximated in bactericidal action the whole blood. One case, however (Case 2), demonstrates that the subject had 1,000 times the bactericidal power of the control. This finding must be disregarded, since there is only one case involved and the condition may be regarded as the result of contamination. The method used is another factor that must be considered if the results are to be evaluated properly. One must realize that the use of equal parts of suspension and blood diluted the blood to half its strength, probably masking its full action.

SUMMARY

1. Whole blood from normal persons is capable of destroying bacteria found in the periapical area.

2. Destruction *in vitro* occurs, probably by lysis.

3. There is some evidence of antibody formation.

4. Patients tend to develop a higher bacteriolytic titer in the blood against their own organisms than against other strains.

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LOCAL USE OF SULFANILAMIDE IN DENTAL PRACTICE

By R. W. Moss, D.D.S., Richmond, Va.

THE discovery of the therapeutic value of sulfanilamide, although of comparatively recent date, has been of such great importance in the advancement of medicine and dentistry that the drug is now classified with other great chemotherapeutic agents such as quinine and arsphenamine.

It is not my intention to dwell upon the systemic use of sulfanilamide, as this has been amply covered by many investigators. This paper will be confined to the local application of sulfanilamide in routine dental practice.

Krashen[1] has reported that the use of sulfanilamide in the alveolus after simple extraction increases postoperative pain and swelling and retards granulation. My experience has been in exact contradiction to this and agrees with that of Edwards[2] and of Kayne.[3] I have used this drug with gratifying results in such conditions as dry socket and difficult traumatic extraction and after removal of acutely infected teeth, especially in partially erupted lower third molars with the typical posterior flap and pocket, which is usually hyperemic and infected and requires an incision prior to the actual extraction. It is reasonable to believe that this drug should not be used in excess, since the therapeutic concentration is quite low. In view of this fact, I have preferred to use it in the form of an ointment. This method of application assures a reasonably constant concentration of sulfanilamide in the immediate area and eliminates pressure and irritation.

Many people seem to be under the impression that the solubility of sulfanilamide is so low that its local application can be of no value. Krashen[1] especially emphasizes this point. That this criticism is not valid can be seen readily when one considers the fact that only 8-10 mg. per hundred cubic centimeters of blood is usually an adequate therapeutic concentration for the systemic treatment of infections, while the solubility of sulfanilamide in blood serum at body temperature is roughly 200 times this value.

The method of administration is very important and better results will be obtained if the dentist uses a painstaking technic in applying the drug. I have used it in more than 300 cases in the past two years in various forms, such as tablet,

powder and vaselin-powder ointment. The most satisfactory form is an ointment consisting of 25 per cent powdered sulfanilamide, 2 per cent benzocaine and 1 per cent eugenol in a lanolin-vaselin base.[1] This ointment maintains its consistency at body temperature and does not wash out of the socket readily or become dislodged by mouth fluids.

If postoperative pain and slow healing are expected, the socket or area is routinely swabbed with metaphen or any other antiseptic of equal value, and then the ointment is inserted. The antiseptic sterilizes the area, and the sulfanilamide ointment, with its bacteriostatic action, prevents the multiplication of bacteria and thus one of the fundamental causes of slow healing and other complications is eliminated. Although benzocaine alone will anesthetize the area, the effect, in my experience, lasts only six to eight hours, and eugenol is added to the ointment for a more prolonged anesthetic action. In more severe cases, in which bony process has to be removed and the tissue is traumatized or lacerated, a wick of iodoform gauze saturated with eugenol is sometimes placed over the ointment in the socket. This is done for two reasons: (1) for a stronger and more prolonged anesthesia and (2) to prevent particles of food and débris from collecting in the socket. It is necessary in some cases, although rarely, to replace the wick every other day for three or four visits. Each time, however, one must be careful not to disturb the ointment in the floor of the socket. If, for some reason, the ointment is not seen to be present, it is advisable to add more and carry out the procedure outlined. In no case where this technic has been used and the patient has cooperated in such matters as not rinsing the mouth or using an ice cap to relieve pain, congestion, etc., has swelling of the submaxillary or other lymph glands, discoloration or marked trismus been noted. These observations have been confirmed substantially by several fellow practitioners, who have cooperated with me by using this ointment in their practice.

J. C. Forbes, associate professor of biologic chemistry, Medical College of Virginia, furnished data on the solubility of sulfanilamide in blood serum.

CONCLUSION

Sulfanilamide, although it is becoming daily more important to us as dentists, is not a cure-all, and at times results are not so rapid and simple as we would like. I am convinced, however, that the use of sulfanilamide reduces infection and irritation and allows granulation to take place more rapidly, thus lessening the discomfort and healing period in the average case.

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EDWARD MAYNARD, A PROGENITOR OF THE UNITED STATES ARMY AND NAVY DENTAL CORPS

By WILLIAM N. HODGKIN, D.D.S., Warrenton, Va.

IN the dental centenary celebration of last year, the profession paid richly merited honor to the historic founders of 1840, with particular and appropriate emphasis on the four towering figures of Horace Hayden, Chapin Harris, Eleazar Parmly and Solyman Brown. This year, in common with all citizens, the profession is concerned with national efforts in building a defense organization. It is especially conscious of the resultant enlargement of the dental corps of the respective branches of service, is aware of their value in the national program and is likewise proud of their personnel. It would appear timely, therefore, to inquire as to a lesser known and inadequately publicized figure of 1840, about whose career is woven at least the prolog, if not indeed the first chapter, of the history of the Dental Corps of the United States Army and Navy.

Reference is made to Edward Maynard, of Washington, D. C., apparently the first to apprehend the health value of dental service to the military and naval forces.

EARLY EFFORTS TOWARD ESTABLISHMENT OF DENTAL CORPS

So many phases of the development of the dental profession have been manifest within our own time that we are prone to regard them as having been conceived on, or just prior to, the date of accomplishment. Thus we are inclined to think of efforts to establish the dental corps of the Army and Navy as occurring just a short time prior to 1901 and 1912, respectively. Actually, organized dentistry took formal action on the subject a year before the formation of the first American Dental Association, and Maynard was using every important contact that he had made in furthering the proposal more than a decade before that. The first action by a dental organization in this relation was taken by the Western Dental Society, July 21, 1858, at a meeting in Quincy, Ill., on motion by H. J. McKellops, of St. Louis.[1] About two weeks later (August 5, 1858), he introduced a similar prevailing resolution before the American Dental Convention, meeting in Cincinnati, as follows:

> Resolved, that the Convention appoint a committee of five to memorialize Congress on the necessity of appointing dentists for service in the regular army, the committee to act in concert with that of the Western Dental Society.[2]

A committee (James Taylor, Cincinnati, Ohio; George Watt, Xenia, Ohio; Frank Fuller, Portsmouth, N. H.; W. N. Atkinson, Cleveland, Ohio, and W. D. Stone, Lexington, Ky.) was appointed in pursuance of the resolution, but the records do not yield information as to what, if any, activity was engaged in by the joint committee of the two societies to further the end for which they were appointed.

A contemporary editorial captioned "Importance of Army and Navy Den-

Read before the North Carolina Dental Society, May 12, 1941.

tists,"[2] presumably by Chapin Harris, notes the priority of Maynard in the field. Reviewing the background of the subject, the editorial of 1859 states that "to our certain knowledge the importance of it [a dental corps in the Army] has been advocated by Dr. Maynard for fifteen years past, at Washington City." It further reveals the interesting story of how nearly he came to accomplishing the formation of the corps of whose value he was so firmly persuaded. Two prominent national figures of the day, highly esteeming him in his professional and extraprofessional capacity, were so helpful to Maynard in his constant advocacy that it has seemed fitting to list their names among the foresighted and influential supporters of the early profession. These were President Millard Fillmore and, in the succeeding (Pierce) administration, Jefferson Davis, Secretary of War. (A natural conjecture arises as to the possible connection of Maynard's contacts with Jefferson Davis and the observation of Koch, among others, that utilization of dentists in their professional capacity was more encouraged in the Confederate than in the Union Army.[4])

The editorial relates that Maynard "so far impressed Mr. Fillmore in favor of the proposal that he brought it before the Cabinet in Council." After this cabinet discussion "The Secretaries of War and the Navy took some action in the matter. Nothing resulted from the former and the latter went to work so stupidly and vexatiously as to make it necessary to countermand his orders in the matter as soon as his term of office expired, which happily occurred within a few days and before his new 'regulation' was issued."

In the Pierce administration, Jefferson Davis, as Secretary of War, "received the proposition as one of great value; and Mr. Dobbin, Secretary of the Navy, to whom he addressed a note upon the subject, at once and heartily, approved the proposition and expressed himself as under deep obligations for humane suggestion."

An unidentified Army surgeon, obviously one with an appreciation of the health value of dental service, strongly favored the proposal and accompanied Dr. Maynard on a visit to the then Surgeon-General (Thomas Lawson). Together, they were "so far successful in advocating the project that the Surgeon-General was willing to advocate the establishment of a corps of Army dental surgeons of six to begin with, to be entirely distinct from the corps of surgeons in their duties, examinations, promotions and rank."

The reason of frustration of these first national legislative plans of the dental profession, after they had reached such a promising stage, probably sounds familiar to those who have worked since in the field: "The time was not favorable. There had been pending before Congress for some time, a bill affecting the corps of surgeons of the army, and it was thought best not to propose anything which might defeat the bill."

The reliance on Maynard's leadership to accomplish the desired ends is acknowledged in the closing words of the editorial, "Although no official action has ever yet been had in the matter the project is daily ripening. We have reason to know that Dr. Maynard misses no proper occasion to advocate and illustrate its propriety to such of his patients, from the President to the common soldier, as may have authority of place, official or legislative, or may be in any way affected by it.

"All approve the measure; and when the favorable time arrives for legislative action, we have no doubt that Dr. Maynard will carry it through successfully."

The favorable time for successful legislative action, of course, did not arrive until a full decade after Maynard's death, in 1891, but the story as told by

his contemporary was of sufficient interest to prompt a search to determine what, if any, confirmation could be gained from official records. Much of the search has been fruitless and disappointing, especially as relates to records of the War Department. Unfortunately, the letters of the period from the secretaries of war to the Surgeon-General are not available either in the National Archives or the libraries of the Surgeon-General and War College. (Arthur F. Isham, of Buffalo, N. Y., checked the Fillmore Papers, in the collection of the Buffalo Historical Society.) However, there is in the Navy Department archives ample confirmation of the initial efforts and of Maynard's rôle as well. The editorial story, being thus confirmed by official correspondence in one branch of the service, may be presumed accurate throughout. Doubtless, the official correspondence itself can best give factual information and is here presented in chronologic order.

Navy Department.
February 16, 1853

Sir:

The President has expressed a wish that this Department would inquire into the propriety of enlarging the requisitions upon Candidates for admission into the Medical Corps, so far as to demand from them a more full knowledge of the science and practice of Dentistry in preparing them for the duties of the Naval service. He is impressed with the belief that more attention to this subject than is ordinarily given would be found to be usefully conducive to the health of officers and men on ship board.

To enable the Department to satisfy the President on this question, I will be obliged to the Bureau under your control for a report, which shall state what studies in dentistry are now embraced within the general requisitions of the Bureau, and the expression of your opinion upon the value or necessity of enlarging the studies of the Medical officers, with a view to a more complete and practical knowledge of the character and treatment of diseases which may be supposed to have any connection with the present improved condition and research of dental science.

Very respectfully
Dr. Harris, Your obt. Svt.
John P. Kennedy.[15]
Bureau of Medicine, &c—

Bureau of Med. & Surgery.
February 21, 1853

Sir:

I have the honor to acknowledge the receipt of your letter of the 16th inst. calling upon this Bureau for a report, which shall state what studies in dentistry are now embraced within the general requisitions of the Bureau, upon the candidates for admission into the Medical department of the Navy; and for an opinion as to the value or necessity of enlarging the studies of the Medical Officers, with the view to a more complete and practical knowledge of the character and treatment of diseases, connected with the present advanced condition of dental science.

With regard to the studies in dentistry now required, I would state that they extend merely to the physiology and pathology of the teeth, and to the practice of such operations on the same, as may be considered essential to the health and comfort of the officers and men on ship board.

As to the necessity or propriety of enlarging the studies of Medical Officers, so as to embrace anything like a complete and practical knowledge of the nicer manipulations of dentistry, I have no hesitation in expressing the conviction, that it is altogether impracticable without a neglect of other and much more important branches of their profession.

Dentistry is regarded as an art separate and distinct from the profession of Medicine, and one requiring a manual dexterity, which can only be acquired by long and extensive practice.

I believe all that is essential to the health and comfort of the sailor, in this regard, is now taught and understood by the Medical Officer, and that to enlarge the scope of his studies so as to embrace the art of dentistry, as now understood, would, so far from adding to, materially detract from the usefulness and efficiency of the Medical Corps.

I would add that the instruments and ap-

pliances, necessary to the practice on board ship, would involve a large additional expense in the Medical outfit of vessels.

I am very respectfully

Hon: Your obt. St.
John P. Kennedy,
Secy. of the Navy Tho. Harris[6]

Navy Department.

February 24th, 1853

Sir:

Your letter of the 21st inst, in reply to one from this Department of the 16th instant, has been received.

I have to request that you will, *for the information of the President,* furnish a further report of the extent of dental science, considered by you as necessary to the Medical Officers of the Navy, to enable them to practice such operations as may be essential to the health and comfort of the Officers and Men of the Navy on ship board, and also to state, whether in view of the limited extent of the practical knowledge of the nicer manipulations of dentistry, acquired by the Medical Officers of the Navy, it is not essential to the health and comfort of the Officers and Men of the Navy, that there should be a skilful Dentist attached to each of the vessels of the Navy or at least one to each Squadron.

I am, very respectfully

Dr. Thomas Harris
Chief of the Bureau
of Medicine
and Surgery Your obedt. Servt.
John P. Kennedy[7]

Navy Department.
Bureau of Med. & Surgery
February 25, 1853

Sir:

I have the honor to acknowledge the receipt of your letter of the 24th inst. calling for a further report as to the extent of dental science considered by me as necessary to the Medical officers of the Navy to enable them to practice such operations as may be essential to the health of officers and men; and whether in view of their limited knowledge of the nicer operations of dentistry, it would not be essential to the health and comfort of officers and men on ship board, that there should be a skilful dentist attached to each of the vessels of the Navy, or at least one to each Squadron.

In reply to the first part of the inquiry, I would state that the Medical Officers of the Navy are required to inform themselves in regard to the anatomy of the teeth, and the surgical treatment of the diseases and injuries to which they are subject:—they must understand the different methods adopted for the relief of pain; the best modes of extraction; the causes and treatment of disorders connected with dentition; the same in regard to the exfoliation of the alveolar processes, and the treatment of abscesses, etc. in that region.

These particulars are mentioned, to give some idea of the extent and character of the information required in regard to the diseases of the teeth and adjacent parts:—which is all that, in my opinion, is essential to the health of the officers and men on ship board.

In so far as dentistry is not embraced in the curriculum of study now required by the Medical Schools of the Country, it is essentially a Mechanical art, demanding a long and laborious apprenticeship to attain the most ordinary skill.

It is taught in none of the colleges of this country, nor in Europe, so far as I am aware.

It would no doubt conduce much to the comfort and convenience of a vessel to have an experienced dentist, but I would state it as my opinion, that one for each Squadron would be amply sufficient.

I am very respectfully

Hon: Your obt. st.
John P. Kennedy,
Secy. of the Navy Tho. Harris[8]

The leadership attributed to Maynard is likewise confirmed by the following letter:

Washington, April 13, 1853

To The Honorable
James C. Dobbin
Secretary of the Navy

Sir:

I respectfully ask for a copy of the Report made to the Navy Department by the Chief of its Medical Bureau upon the subject of employing Dental Surgeons in the Navy.

I learn from the late President, to whom I had the honor of proposing the employing

such Surgeons, that, at his request reports were made upon the subject.

I have the honor to be
Sir,
Your Obt. Servt.,
Edward Maynard[9]

Interpretation of correspondence is recognized as a questionable practice, and certainly I make no exhaustive attempt in such hazardous pastime. But it does appear obvious from the letters, supported by related material in the study, that interest and impetus in the proposal were more pronounced in the office of the President itself, diminishing and yielding in succession what minimum ground seemed necessary as communications followed in the official channels below. A natural temptation arises to interpret the letters in determination of what procedure of the inept Secretary of the Navy was regarded as so "stupid and vexatious" as to draw the flaying editorial expression. Was it the approach to the problem by "enlarging the requisitions upon Candidates for admission into the Medical Corps, so far as to demand from them a more full knowledge of the science and practice of Dentistry"? In view of the known persuasion of the dental leaders of the time, this seems very likely.

Washington April 13 1853

To the Honorable
James C. Dobbin
Secretary of the Navy

Sir,

I respectfully ask for a copy of the Report made to the Navy Department by the Chief of its Medical Bureau upon the subject of employing Dental Surgeons in the Navy.

I learn from the late President, to whom I had the honor of proposing the employing such Surgeons, that, at his request reports were made upon the subject.

I have the honor to be
Sir
Your Obt. Servt.
Edward Maynard

In any event the proposal died aborning, and while the early efforts were recalled in the happier chronicles of 1901 and 1912, they have largely been forgotten in more recent years.

MAYNARD BIOGRAPHIC NOTES

Let there be no deduction that the fame of Edward Maynard in the annals of the profession depends solely on the two phases of his career to which this paper is necessarily limited. Likewise, it would be an error to presume as in any way fortuitous his rôle of leadership in the early proposal of service dental corps. He was well qualified for this leadership and merited the confidence so fully acknowledged by the profession. In truth, Maynard appears to measure up to the illustrious dental quartet of his time, and probably his very versatility has contributed to the lack of general recognition of his qualities and achievements. That his influence on the advancement of his profession may be estimated, it is perhaps well to briefly sketch the man. Disjointed biographic notes doubtless will suffice.

Edward Maynard, A.M., M.D., D.D.S. (all degrees honorary), was born April 26, 1813, at Madison, N. Y., the son of Moses and Chloe (Butler) Maynard. His father was at one time a member of the New York Legislature.

After a preparatory course at Hamilton Academy, he entered the United States Military Academy, in 1831. Physical disabilities caused his resignation before graduation at West Point and he gave brief attention to civil engineering and architecture.

Prior to 1835, he received some dental training as an apprentice, and in 1836 we find him in Washington, beginning his practice of dentistry, which he continued, with some interruptions on trips abroad, until 1890. Here, he succeeded the famed James S. Gunnell as the outstanding practitioner of the growing Capital City, and over a period of years enjoyed a clientele which included several presidents and a host of national figures of the times.[10]

On organization of the American Society of Dental Surgeons, Dr. Maynard, by invitation, became an original member and was appointed to the Committee on Seals, Diplomas, Etc.[11]

In a group which included two so talented as were Solyman Brown and Eleazar Parmly, his artistic ability was obviously well known when it is noted that "The insignia, or coat of arms of the American Society of Dental Surgeons (also adopted by the *British Journal*), designed and drawn by one of the most talented and esteemed members of the body, Dr. Maynard of Washington City, is a polyandrian column," etc.[12] This seal was carried on the diplomas of the society and the title pages of the first series of the journal.

Figure 2.

Beginning in 1842, Maynard served with L. S. Parmly, E. Townsend and others on the Executive Committee of the American Society, where, as always, his work drew praise. Report of the 1842 meeting states: "Dr. Maynard of Wash-

ington City was the only member of the Executive Committee in attendance, consequently the whole business of that important committee devolved upon him, but it could not have fallen into better hands. But for the prompt and systematic manner in which the business of this committee was presented, its [the society's] meeting would have continued at least a day longer."[13]

With Chapin Harris, Solyman Brown and Eleazar Parmly, he served on the committee appointed to draft resolutions "in relation to the demise of Horace Hayden."[14]

In the field of dental literature, Maynard played a full part. He was made associate editor of the *American Journal of Dental Science* when the society took over its publication in 1840.[15] In 1843, he became coeditor of the journal, serving with Chapin Harris and Amos Westcott.

He was among that small group of generous dentists who subscribed funds to make possible the first volume of the journal.[16]

His published papers disclose a wide range of interests, from diversity in form, situation and capacity of the antra to a study of dental fibrillae.

He is said to have introduced the technic of filling root canals with gold foil.[17]

As early as 1842, Maynard was inveighing against the use of solutions containing mineral acids for the removal of calcareous tartar.[18]

As a preceptor, he was an early proponent of "aptitude testing" and held to the dictum, "The hands of the dentist should be educated as well as the head." He once wrote, "We are frequently applied to for instruction in our profession, and the first question we ask the applicant is, 'Have you been accustomed to any pursuit requiring some mechanical skill, and the use of the hands?' If not, the man is dismissed as not being prepared to commence his studies—advised, perhaps, to turn his attention to law, or some other profession that requires the head *only* to be educated."[19]

Dr. Maynard was obviously advanced and thorough in his teaching methods. In 1844, he was advising those dentists undertaking to teach students to have copies of all varieties of human teeth made in clear glass, into which were cut cavities of various types. The cavities, when thus cut and polished (by Mr. Simpson, lapidary seal-engraver of Baltimore), enabled the student to observe the base and walls, as well as the surface, of the filling.[19]

He was probably the first to practice the reproduction of rugae in dentures, and his comment thereon is a lone instance of any personal claim: "We take some little credit (with all due modesty) for pointing out the use of the rugae." He continues with a description of their function and the observance that "if these rugae cannot be stamped up, they should be soldered on."[20]

Dr. Maynard was one of the eighteen distinguished dentists who comprised the group first to receive the honorary degree of doctor of dental surgery from the Baltimore College of Dental Surgery (February 18, 1842).[21] In 1847, with Amos Westcott and J. H. Foster, he was appointed a delegate from the American Society of Dental Surgeons to the National Medical Society. He was appointed to the chair of theory and practice at the Baltimore College of Dental Surgery in 1856,[17] and held a like position in the National University (Washington) from 1887 until his death.[17] He was an honorary member of the American Academy of Dental Science and of the European Society of American Dentists; and was also a member of the International Medical Congress.

Dr. Maynard went to Europe in 1845 and, while in St. Petersburg, was employed as court dentist to Emperor Nicholas I of Russia, on solicitation of Dr. Arndt, court physician. Thereafter, he

was offered a post with the resounding title of "Actual Dentist to His Imperial Majesty," with the rank of major and a munificent salary. The post was declined but "the Emperor forced upon the doctor a magnificent diamond ring."[22] His European trip appears to have been a veritable succession of honors—the Medal of Merit from the King of Sweden, seldom bestowed upon a foreigner, and the order of Chevalier of the Military Order of the Red Eagle from the King of Prussia, and personal compliments from the King of Belgium.[17] While these honors, save the grateful attentions of Emperor Nicholas, were in recognition of extraprofessional accomplishments to be cited later, he lent appreciably to the prestige of the American profession abroad even in a short stay.

The Washington office of Dr. Maynard was on Pennsylvania Avenue near Eleventh St., by coincidence scarcely a stone's throw from the National Archives, in which many records relating to his career are now housed. His early residence was on L Street, just off Pennsylvania Avenue, present site of Columbia Hospital for Women, vacated by Maynard (1866) to become the premises of the British Legation while Sir Frederick Bruce was minister.

Maynard died May 4, 1891, after fifty-five years spent in utilizing his influence in wide and highly placed contacts for the advancement of dentistry. His passing was noted, in addition to the usual obituaries in dental periodicals, by resolutions in many state societies, and these reflect the genuine expression of those who had fresh and full knowledge of his contributions. In the resolution of the Virginia State Dental Association, for instance, he is designated as that "prince of dentists."[23]

He is buried in Congressional Cemetery, Washington, where his grave is marked by a simple shaft with an epitaph as modest as was the life it records:

EDWARD MAYNARD
SURGEON-DENTIST
AND
INVENTOR
1813-1891

MAYNARD AND THE DEVELOPMENT OF SMALL ARMS

Varied and notable as were his contributions to his profession, Maynard was even more widely known in the military world for his achievements in the improvement of small arms. When physical disabilities forced him, as a youth of 18, to abandon his initial interest by resigning at West Point, it seems certain that the United States Army lost a cadet who would have become one of the most brilliant figures in the history of the Ordnance Department. Even with a brief cadetship, and a later full career in the profession to which he so greatly contributed, the records of the War Department are replete with the testimony of world-wide interest and official recognition of his contributions in the field of armament.

In 1845, Maynard invented the tape priming system (U. S. Patent 4208.) This consisted of a coiled tape containing fifty fulminate caps spaced at equal distances and a mechanism which fed the tape, a cap at a time, into position for firing. In effect, this development superseded the old percussion cap and elicited the keen interest of military experts throughout the world. In Special Orders No. 3 (January 21, 1845), "The Secretary of War directs that Bvt. Brig. Generals G. M. Brooke, George Gibson and Capt. A. Mordecai of the ordnance be detailed . . . to meet at the Washington Arsenal as soon as practicable for the purpose of examining the percussion-lock for firearms recently invented by Dr. Edward Maynard, and reporting upon its adoption to the service." Likewise, "J. Y. Mason, Secretary of the Navy, directs that Commodore Charles Stewart

and Commander Levin Powell meet therewith those detailed by the Secretary of War for purpose as above."

The joint board, after exhaustive tests, January 29, 1845, reported in part the following conclusions to the secretaries of the war and navy departments:

> With respect to Maynard's lock, the Board is of the opinion that the principles on which the lock and its priming are constructed may be applied with great practical utility to firearms in general; that the apparatus for the purpose is exceeding ingenious, and accomplishes most of the objects proposed by the inventor.[24]

On March 20, 1845, the War Department negotiated a contract between Secretary W. L. Marcy and Maynard, authorizing the use of the invention by the United States on a graduated royalty scale.[25] More than 100,000 arms were fitted to the new system under the terms of this contract and, in 1853, the government purchased for $50,000 the entire right to use the Maynard lock and primer.[26] Ordnance reports disclose that, by the year 1859, the improvement had been applied to more than 300,000 small arms of the United States Army. Models as early as the rifle muskets of 1822 and 1842 were brought to date by alteration to the Maynard principle.[27] The possibilities in thus reclaiming obsolete small arms is suggested by secretarial endorsement on "Report on subject of Doctor E. Maynard's proposition to have a trial made of his plan for altering Flint locks to his principle of firing," which incidentally contains a compliment to Maynard. The secretarial endorsement is partly as follows:

> The recommendation for trial is approved —and should it hereafter be deemed advisable to alter Flint lock muskets by contract, it will be rather desirable to make a contract with the inventor, not to remunerate him . . . but to secure his zeal and intelligence in the application of his invention.
>
> War Department Jeff'n Davis,
> Oct. 3, 1855 Secretary of War[28]

Interest in the improvement was not confined to the War Department, for the Bureau of Ordnance and Hydrography, in 1854, made a request for 200,000 Maynard Primers for the Navy, the request being granted.[29]

The wide interest in the improvement is indicated by inquiries from foreign officials and the courtesies of the War Department in furnishing reports of trials and other information to the chancellor of the Belgian Legation, the charge d'Affaires of Sweden and Norway, the Brazilian minister and others.[30]

At about the time his invention was being so well received by the United States government, Maynard entered a contract (February 10, 1845) with Thomas L. Smith, of Washington, and J. Washington Tyson, of Philadelphia, giving each a third interest up to a certain figure in proceeds from his invention "in all quarters of the world outside the United States." A possible practical reason for the disposal of part interest likely is found in the condition that "said Smith and Tyson shall alone be responsible for the manufacture of two machines for making priming, and also for the manufacture of such locks as may be required to exhibit its advantages abroad." An interesting condition of the contract, accurately anticipating foreign honors, reads as follows:

> It is further understood and agreed by and between the parties to this agreement, that no present to the inventor from an Emperor, King, Sultan, Governor or other ruler or potentate, is included in this agreement, but is to be retained by the said Maynard for his own exclusive use and benefit.[31]

Under the partnership, most of the prominent gun-making firms of the country were employed or in some way connected with the manufacture of the improvement. Deringer, Butterfield and Nippes, Sharpe, Massachusetts Arms Co. and Remington and Sons all were so engaged from time to time.

At the height of world wide interest in the improved mode of priming the explosives of rifle ammunition, Maynard contributed another development which was as significant in the military field. In 1851, he patented his "Improvement to Breech-Loading Fire-Arms" (U. S. Patent 8126), which, with subsequent improvements by him over fourteen years, "brought about the general adoption of the Maynard rifle by governments and sportsmen throughout the world."[17] This, of course, was the change of the old muzzle-loader into the breech-loader.

Maynard was not, in this instance, the inventor of a new principle as in the priming system. The breech-loading principle was well known in prior years and even some of the Old Flint locks in this pattern were made at the Harper's Ferry Arsenal and issued to the troops as early as 1814. But it was not until as late as the battle of Gettysburg that that breech-loader became popular for troops of all services.[32] However, the Maynard rifle was one of the earliest practical forms of the breech-loaders[33] and was in demand during the war between the states. The federal government purchased more than 20,000 during the period of the war and it was used extensively by southern sharp-shooters.[34]

From one or two sources, I have heard mentioned a letter said to have been written by Abraham Lincoln, as President, to Maynard in which was contained the reported expression that Maynard's contributions had tripled the size (effectiveness) of the Union Army. Whether the letter actually exists or existed will have to be established by another, for diligent search has failed to yield it. (Acknowledgment is made of the valued aid of Dr. Harlan H. Horner in searching the Lincoln bibliographies for possible reference to the elusive letter.) At any rate, Mr. Lincoln had ample basis for the attributed expression, as the following excerpts from an official report will disclose:

December 4, 1854
Annual Report Secretary of War

Experiments show that the new weapon . . . is at least, *equally effective at three times the distance.*

The increased efficiency of these new patterns of arms will be further increased by an improved mode of priming, invented by Dr. Edward Maynard, which has been approved by the highest officers in our military and naval services.

Your obedient servant,

To the President of the United States — Jefferson Davis, Secretary of War[35]

A similar, but somewhat less extravagant appraisal was made by Maj. Gen. Rosecrans in a letter to Hon. E. M. Stanton, Secretary of War, under date of November 30, 1863. Making a favorite of neither the Maynard nor Burnside patterns, those most mentioned in ordnance reports of the period, he writes:

It (breech-loader) would add not less than 50%, to the force or power of the troops now in the field. In other words *we should augment our Army One Half* by changing the weapons.[36]

Possibly a more convincing testimony to the efficiency of the Maynard rifle than Jefferson Davis ever expressed in direct and official mention may be found in the indirect tribute of a communication written under a signficant date when the procurement of the most efficient arms was of great concern. The letter was addressed to the Governor of Louisiana and follows in part:

Washington, D. C.
December 26, 1860

Gov. J. J. Pettus
My dear Sir:

With this I enclose you a letter from the agent of the Hazard Powder Company from which you will see that you can get the powder you want at N. Orleans and I have written him that you would inform him by telegraph as to the amount of each you

would take. . . . This morning Thompson went with me to Mr. Riggs and we closed the reserved question on the Maynard rifles. I hope however that, before this, some of them are on the way to you.

Your Obedient Servant,
Jefferson Davis[37]

The Priming System and the Maynard Rifle were the most conspicuous of Maynard's achievements in the development of small arms, but this genius provided many other important improvements. Among these is a method of joining two rifle or shot-gun barrels to permit longitudinal expansion and contraction, a device to indicate the remaining number of shells in the magazine of repeating fire-arms, metallic cartridge cases which greatly increased precision of fire and elevated rear sights. Some idea of the scope and significance of his contributions may be gained today by the visitor to the Smithsonian Institution, where will be found no less than seven items credited to Maynard in the exhibit depicting the evolution of small arms.

No. 1406—U. S. Army Musket (1863) Muzzle-loader converted to breech-loader by Edw. Maynard's invention (2 specimens).

No. 152,653—Dr. Edward Maynard's Tape Primer Lock.

No. 168,165—Dr. Maynard's Target and Hunting Gun.

No. 251,160—Refinement of Tape Primer Lock.

No. 252,570—Springfield Musket (1841), Equipped with Maynard Lock.

No. 252,580—Springfield Musket (1863), showing Maynard's invention of bolt-lock mechanism.

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SUITABILITY OF BUTYN FOR INJECTION ANESTHESIA IN ORAL SURGERY*

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BUTYN is a local anesthetic closely resembling procaine in chemical structure, but differing from it considerably in potency and actions. As a topical local anesthetic, it is about ten times as strong as procaine, which makes it one of the most effective of this type. When injected into tissues, it is also highly active, although its potency is not much greater than that of procaine. Butyn suffers from the general defect that in animals its toxicity is considerably higher than that of procaine, and its use has had more reactions in patients.

Butyn has been used by the medical profession with satisfaction for many years in selected types of local anesthesia. Its use in dentistry for anesthetizing the mucous membranes under various conditions[1] has attained considerable popularity, but it has not been used to any considerable extent for injection anesthesia until recently. In view of these facts, it was thought worth while to determine whether butyn was a useful and desirable local anesthetic for injection in oral surgery. It was also thought important to ascertain to what extent the added systemic toxicity, which butyn possesses, modifies the clinical results obtained under conditions of dental practice, and whether this toxicity is great enough to counterbalance its greater anesthetic power.

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Research supported in part by grants from the California State Dental Association. The butyn used in this study was supplied by the Abbott Laboratories.

METHODS

Butyn was compared with procaine in a series of 231 patients in the oral surgery clinic of this institution. The butyn solution consisted of butyn sulfate, 0.75 per cent; sodium bisulfite, 0.1 per cent; potassium sulfate, 1.85 per cent, and epinephrine, 1:60,000. Sulfate rather than chloride was used to make the butyn solution isotonic, since butyn is a sulfate salt which is precipitated by chlorides. The 1:60,000 concentration of epinephrine was used because this strength is commercially available in butyn solutions marketed for dental use. The procaine solution, the standard used by us in many previous investigations, contained 2 per cent procaine hydrochloride, 0.1 per cent sodium bisulfite and 0.7 per cent sodium chloride, all dissolved in a 1:50,000 epinephrine solution.

The two mixtures differed slightly in the strength of epinephrine, but had the same concentration of sodium bisulfite. This is important since we have shown recently that sodium bisulfite, in this strength, causes a certain amount of irritation.[2, 3] The potassium sulfate of the butyn solution was not used with the procaine, but rather sodium chloride. However, in a previous report,[4] we showed that this difference in composition did not affect the local anesthetic potency.

The solutions were supplied to the oral surgery clinic according to the usual "blind-test" procedure, which we have employed many times before and which is described in previous articles in THE

JOURNAL.[2, 4] In brief, this procedure consisted in having the solutions made up by one of us and supplied to the oral surgery staff in bottles which were identified only by number, so that no operator knew the composition of the solutions to be injected. The numbers of the solutions were changed at intervals of several weeks, the same solution being supplied under a variety of numbers, in order to make it unidentifiable in the clinic. The reactions of the patients were recorded by one of us who has had many years of experience in such observations. Events during the local anesthetic procedure were recorded at the time on a special mimeographed form prepared for this purpose. When the tests were finished, the records were segregated according to the solution used, the results tabulated and the averages computed together with the statistical constants necessary for their interpretation.

TABLE 1.—NUMBER AND DISTRIBUTION OF PATIENTS IN CLINICAL COMPARISON OF BUTYN AND PROCAINE AS LOCAL ANESTHETICS IN DENTAL OPERATIONS*

Solution	Total Number of Patients	Total Number of Injections	Average Injections per Patient	Type of Injections Number and Percentage of Total Cases		
				Mandibular	Tuberosity	Infra-Orbital
Procaine	123	193	1.57	72 37.3%	59 30.6%	62 32.1%
Butyn	108	182	1.69	73 40.1%	63 34.6%	46 25.3%
Totals	231	375	1.62	145 38.7%	122 32.5%	108 28.8%

*The butyn solution was 0.75% with 1:60,000 epinephrine; procaine, 2% with 1:50,000 epinephrine.

CLINICAL RESULTS

Type and Distribution of Patients.—One hundred and twenty-three patients were given procaine solution injections, and 108, butyn; a total of 231 for the entire series. Because some patients required blocking of more than a single nerve or region, the patients receiving procaine were given 193 injections, or an average of 1.57 per patient (Table 1), and the patients receiving butyn, 182 injections; or an average of 1.69 each.

The injections were classified as mandibular, tuberosity or infra-orbital block, there being only two or three cases of mental and infiltration anesthesia in the entire series. Since the latter were too infrequent to permit satisfactory analysis, they have been omitted. Mandibular blocks were made in 38.7 per cent of the injections; tuberosity in 32.5 per cent, and infra-orbital in 28.8 per cent, and there was approximately an equal proportion of the different types of injections in each series. Therefore, this was a fairly homogeneous group of patients; which is important for interpreting the results, inasmuch as the characteristic responses to the solutions might vary with the type of injection. If so, it would be necessary to establish in advance that the same proportions of each injection were made with each drug, in case average results were to be compared.

Volume Required.—The average volume required for operation was 5.4 cc.

of procaine for each patient as compared to 5.6 cc. for butyn. This indicated that perhaps butyn was slightly less effective, since it was used in slightly larger volume. However, the data in Table 1 show that the patients receiving butyn were given a slightly larger number of injections each than the patients receiving procaine. Therefore, when the total volume for each patient was divided by the number of injections received by each, the procaine was found to produce anesthesia with an average volume of 3.43 cc. per block, and butyn with 3.33 cc. These data indicate that the volumes of solutions required were nearly the same for the two agents, within the range of variability of the patients. In other words, 2 per cent procaine had the same anesthetic power as 0.75 per cent butyn.

Onset and Duration of Anesthesia.—With procaine, anesthesia developed in an average of 2.8 minutes, as compared to 2.9 minutes for butyn, a difference too small to be significant. The duration of procaine anesthesia was 2.7 hours, as compared to 3.6 hours for butyn. The 1.7 per cent probability value for this difference indicated there were only 1.7 chances out of a hundred that a difference this large could have occurred from accidental variations between patients. Therefore, it is highly probable that the butyn-produced anesthesia was considerably longer than the procaine. One hour of added duration of anesthesia after butyn might be of some clinical value, although ordinarily oral surgical operations are completed in much less time than this, and a greater duration might not necessarily be desirable.

Effects on Vital Functions.—The average changes in pulse rate, blood pressure and respiration are summarized in Table 2. These changes, which were about the same with both procaine and butyn, consisted of almost equally frequent increases or decreases, so that the average changes were rather small. Therefore, there was no basis for discrimination between the two anesthetic

TABLE 2.—COMPARISON OF AVERAGE EFFECTS OF BUTYN AND PROCAINE LOCAL ANESTHETIC SOLUTIONS*

	Volume Required Cc.	Onset of Anesthesia Minutes	Duration of Anesthesia Hours	Pulse Rate Change in Beats per Minute	Blood Pressure Changes Mm. Hg.		Respiratory Rate Changes per Minute
					Systolic	Diastolic	
Procaine	5.4	2.8	2.7	+5.1	+1.7	−2.3	+1.1
Standard error of average	±0.29	±0.12	±0.24	±1.04	±1.10	±0.90	±0.34
Butyn	5.6	2.9	3.6	+3.8	+0.6	−2.4	+0.6
Standard error of average	±0.32	±0.15	±0.32	±1.28	±1.58	±1.08	±0.41
Probability of differences being accidental	58%	68%	1.7%	45%	57%	95%	34%

*The standard of error values indicate the amount of variability to be expected in the average value to which they relate. The probability value represents the odds that the differences between the averages could have resulted from chance. The lower the probability percentages, the greater is the chance that the differences are true differences and not the result of accidental fluctuations in the individual values. The probability value should be smaller than 5 per cent before it is safe to conclude that a true difference exists between the solutions.

solutions from this standpoint. In animals, butyn is much more toxic for these functions than procaine, and therefore was expected to produce greater changes than were observed in these patients. However, since the amounts of butyn injected in dentistry are smaller than those required in most other forms of surgery, such toxic effects might not be important in the dental field of application.

Course of the Anesthesia.—Injection of the solutions was painful in 14 per cent of the procaine cases as compared with 52 per cent of the butyn. (Table 3.) The painfulness referred to was not the pain caused by the prick of the needle, but the actual pain from the solution as it came in contact with nerve structures within the tissues. These results indicate that, at first, injection of butyn caused irritation, in almost four times as many patients as did injection of procaine. Calculation of the probability that this was a true difference revealed that there were extremely high odds against this being accidental. Such production of pain marks a serious defect in the butyn solution, making it somewhat undesirable for injection anesthesia.

If there were an inadequate anesthetic power in one of the solutions, it might be revealed by frequent incomplete anesthesia. Completeness of anesthesia was governed primarily by the accuracy with which the solution was injected into or around the nerve which was being blocked. However, even when the solution is injected into the nerve sheath, the completeness of blockage of the individual fibers depends to a considerable extent on the ease with which the anesthetic solution penetrates. Table 3 shows that 20 per cent of the patients, or one out of every five, had incomplete anesthesia when procaine was used; as compared to 25 per cent, or one out of every four, with butyn. In view of the variability indicated by the standard errors, this difference is too small to warrant the conclusion that butyn was actually less desirable in this respect than procaine.

At the end of each operation, the surgeon recorded his clinical impression as to whether the anesthesia had been

TABLE 3.—FREQUENCY OF IMMEDIATE EFFECTS OF BUTYN AND PROCAINE LOCAL ANESTHETIC SOLUTIONS, EXPRESSED AS PERCENTAGES OF NUMBER OF CASES IN EACH SERIES

	Incomplete Anesthesia	Painful Injections	Amount of Bleeding			Side Actions				Completely Satisfactory Anesthesia
			Slight	Moderate	Excessive	Perspiration	Nervousness	Tremor	Faintness	
Procaine	20.0	14.1	11.9	58.5	29.7	18.3	34.7	8.3	5.8	83.9
Standard error of percentage	±3.58	±2.51	±2.96	±4.54	±4.26	±3.53	±4.33	±2.51	±2.23	±3.30
Butyn	25.0	51.9	8.8	53.6	37.6	30.2	53.3	8.9	15.1	78.7
Standard error of percentage	±3.19	±3.70	±2.10	±3.71	±3.60	±3.43	±3.72	±2.13	±2.70	±3.18
Probability of differences between values being accidental	30%	less than 0.001%	40%			0.2%	0.1%	85%	0.8%	25%

satisfactory. This was based on the completeness of anesthesia, the speed, onset, duration, painfulness and other characteristics which might contribute to a subjective impression of its general satisfactoriness. With procaine, 83.9 per cent of the anesthesias were designated as being completely satisfactory, as compared to 78.7 per cent with butyn. This was a slight difference against butyn, but again the probability calculation showed that it was too small to permit conclusions as to a superiority for the procaine. Therefore, about four out of five anesthesias were considered entirely satisfactory from the clinical standpoint at the time of operation, with either agent.

a difference between the drugs, as shown by the probability percentage. Apparently, the lower concentration of epinephrine in the butyn solution was adequate to control the bleeding.

Reactions.—The side effects, or reactions, observed during the course of the operation were tabulated under the headings of perspiration, nervousness, tremors and faintness. Faintness was said to be present whenever the patient felt sufficiently faint that the operation had to be temporarily interrupted. Since complete fainting with loss of consciousness occurred rarely, the frequency of faintness recorded in Table 3 represents not only this reaction, but also minor degrees of the same general phenome-

TABLE 4.—FREQUENCY OF POSTOPERATIVE EFFECTS AFTER USE OF BUTYN AND PROCAINE LOCAL ANESTHETIC SOLUTIONS, EXPRESSED AS PERCENTAGES OF NUMBER OF CASES IN EACH SERIES

	Late Pain at Injection Site	Swelling at Injection Site	Trismus	Septic Alveolus (Dry Socket)	Inflammation at Operative Site
Procaine	35.9	38.2	41.3	7.9	71.1
Standard error of percentage	±5.43	±5.57	±5.69	±3.09	±5.20
Butyn	32.6	30.3	40.4	15.6%	60.7
Standard error of percentage	±4.97	±4.89	±5.20	±3.82	±5.18
Probability of differences between values being accidental	65%	28%	91%	12%	16%

Amount of Bleeding.—The amount of bleeding is governed by the nature and extent of the operation as well as by the potency of the vasoconstrictor. Since butyn was used with a weaker concentration of epinephrine than was procaine, an increased amount of bleeding might have been expected with butyn. The data in Table 3 show that slight and moderate degrees of bleeding were approximately equally frequent with the two solutions and that excessive bleeding was observed in 29.7 per cent of the procaine and in 37.6 per cent of the butyn patients. This difference against the butyn was not large enough to prove

non. Perspiration occurred in 18.3 per cent of the patients after procaine, and 30.2 per cent after butyn anesthesia. (Table 3.) This difference against butyn is large enough to be highly significant, as shown by the probability percentage. Nervousness occurred in 34.7 per cent of procaine anesthesias, as compared with 53.3 per cent of butyn; another difference against butyn too large to be explained on the basis of accidental variations between patients. Tremors occurred in 8.3 per cent and 8.9 per cent, respectively, indicating no difference here. However, faintness was observed in 5.8 per cent of the procaine cases, but in

more than twice as many, or 15.1 per cent, of butyn. Again this difference was too great to be explained on the basis of chance variations between individuals. Considering all these side actions together, it was apparent that, aside from tremors, butyn injection caused perspiration, nervousness and faintness about twice as frequently as did procaine. Therefore, definite symptoms, undesirable from the standpoint of the comfort of the patient, were produced by butyn injection during the operations too frequently to be ascribed to accidental differences.

Postoperative Course.—Pain at the site of injection of the anesthetic solution occurred postoperatively in 35.9 per cent and swelling in 38.2 per cent of the patients receiving procaine, and pain in 32.6 per cent and swelling in 30.3 per cent of those receiving butyn. (Table 4.) Trismus, or muscle spasm, was observed in 41.3 per cent of the patients after procaine injection and 40.4 per cent after butyn; frequencies which were practically identical. Septic alveolus, or dry socket, arises from a variety of mechanisms only some of which can be ascribed to injection of the local anesthetic solution. However, in this series, there were 7.9 per cent of these reactions after procaine, as compared to 15.6 per cent after butyn anesthesia, a value which gave a 12 per cent probability of true difference. Inflammation at the site of the operation is caused primarily by the operative procedures, rather than by use of the local anesthetic solution. However, if one local anesthetic solution caused longer vasoconstriction and kept the operative areas bloodless longer than another, there might be a greater opportunity for infection than with shorter vasoconstriction. With procaine, 71 per cent of the patients had inflammatory reactions at the operative site during the postoperative period, while with butyn this value dropped to 60.7 per cent, a difference great enough to have a 16 per cent probability of being significant. This is not small enough to be reliable, but indicates that butyn injection possibly resulted in less inflammatory reaction after the operations than did procaine. Considering the postoperative effects as a group, it would appear that, trismus being the same, septic alveolus increased, and pain and swelling possibly decreased, and the sequelae of butyn injection were probably about the same as those after procaine.

DISCUSSION AND SUMMARY

From the results with butyn previously published, it might have been anticipated that its local anesthetic efficiency would be higher than that of procaine, both in intensity and in duration, and that it would have a greater effect on blood pressure, pulse and respiration than procaine, together with greater local tissue injury. However, the clinical results in this report indicate that when 2 per cent procaine is compared with 0.75 per cent butyn, the anesthetic potencies are about the same as judged by the volumes of solutions required, speed of onset and completeness of the anesthesia. Butyn had a longer action. At the time of injection, the butyn solution appeared somewhat less desirable, since its injection caused pain by direct irritation in about one-half the patients as compared to only one-seventh with procaine. Comparison of the changes in pulse rate, blood pressure and respiration showed that, although both solutions might cause marked alterations in these functions in either direction in the individual patient, the average effects were similar. The data, however, indicated that butyn was not appreciably more toxic for these functions than procaine, when used in the concentrations and volumes employed in dental local anesthetic injections. The operations in which butyn was used were apparently not complicated by any more cases of excessive

bleeding than those in which procaine was used, at least within the range of variability of this type of data. This is of some significance, since the butyn solution contained 1 :60,000 epinephrine, which was weaker as a vasoconstrictor than the 1 :50,000 epinephine present in the procaine, and, therefore, more blood in the operative fields might have been expected.

Butyn appeared at a disadvantage in comparison to procaine in the frequency of reactions during the operation. Although tremors were substantially the same with the two anesthetics butyn was definitely worse than procaine as regards perspiration, nervousness and faintness. The differences were too great to be considered accidental. Therefore, patients who received the butyn solution were more uncomfortable while they were in the operating chair than were those receiving procaine. However, during the postoperative period, the recovery was much the same with the two agents. These differences indicate that butyn is a useful local anesthetic, having the advantage over procaine, in the concentrations now used, of longer action, but suffering from the disadvantage of more undesirable effects during the course of the operation.

CONCLUSIONS

1. Butyn, 0.75 per cent, was compared with procaine, 2 per cent, in 231 patients subjected to oral surgical operations, using the "blind test" procedure.

2. The same volumes of the solutions were required, the speed of onset of anesthesia was the same, but butyn-anesthesia persisted approximately one hour longer than procaine-anesthesia.

3. Both solutions modified the pulse rate, blood pressure and respiration in similar degree and in the same direction; therefore, there was no difference between them as regards these functions.

4. The injection of butyn caused pain in about four times as many patients as did the injections of procaine; this indicating that the butyn was somewhat more irritating to the tissues when first injected.

5. Incomplete anesthesia occurred somewhat more frequently with butyn than with procaine but the difference was too small to be significant. The amount of bleeding during the operation was much the same with the two solutions, indicating that neither had an advantage in this respect.

6. Perspiration was produced by procaine injection in 18 per cent of the patients, as compared to 30 per cent by butyn. Nervousness occurred in 34 per cent of the procaine-cases as compared to 53 per cent of the butyn. Faintness occurred in 5.8 per cent of the procaine-cases, and in 15.1 per cent of the butyn. These results indicate that butyn injection had reactions much more frequently than did procaine during the course of the operation. However, in spite of these differences, the operators thought that anesthesia was satisfactory in 78.7 per cent of the butyn-cases as compared to 83.9 per cent of those receiving procaine.

7. During the postoperative period, pain and swelling at the site of the injection, trismus of the muscles from irritation and inflammation at the operative site were similar after the two solutions, within the range of individual variations. However, septic alveolus occurred in 15.6 per cent of the patients receiving butyn, and in only 7.9 per cent of those receiving procaine, indicating possibly another undesirable action of butyn.

8. The net result of these observations is the conclusion that when 0.75 per cent butyn is used in place of 2 per cent procaine for local anesthesia in oral surgery, a longer anesthesia will result which will be accompanied by more pain on injection and more reactions during the course of the operation. Therefore, butyn would seem to have no advantage

over procaine sufficient to outweigh its potential disadvantages, and procaine remains the anesthetic of choice for injections in dental local anesthesia. However, if there is a definite reason that procaine should not be used, butyn can be injected with assurance that it will be an effective and relatively satisfactory local anesthetic solution.

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DENTAL ACRYLICS: A NEW USE AND ABUSE

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THE modern application of acrylics in dentistry has great possibilities. The profession is no doubt right in following the trend in utilizing methyl methacrylate in inlays, jackets, bridgework and facings. The danger lies in being too hasty in adopting it widely. Too many operators are using the material as a panacea without considering its limitations. A great number of laboratories, in order not to be left behind, are attempting to give technical service without the proper technic, and with improper shades of the material.

In speaking of improper shades, we refer to some of the products that are now on the market. Several are excellent, but there are many which will prove a discouragement to the dentist. There is nothing more damning than a restoration that is off color, because the patient can really judge by appearance only. All technical merits of the case mean nothing to the layman.

The powders used in this technic have been experimented with for several years. The present shade guide for the technic is the New Hue. Many other standard shades have been added, to give a wide range of shades. If shade 65 is indicated, a blend which is 65 is used. There is nothing left to chance or variation. Translucency is easily obtained by a constant method. Most of the translucency seen in the acrylics today seems artificial and glassy, but this condition is not the fault of the acrylic.

The cavity preparation or the preparation of the abutment varies but little from the regular operative technic. For inlays, a deeper cavity is indicated than for gold foil. However, there is not so much destruction of dental tissues as is required for porcelain inlays. In preparing for the acrylic jacket, the technic is the same except that a shoulder is not indicated. If one is made, it should have a bevel.

The impressions are poured as usual. An impression of the jacket die is taken with compound in a copper cup and poured in stone. A thinner mix is used than for larger models. If the case is one of a bridge, a duplicate model is made in stone from the master model. The acrylic resin is processed on the

stone die. When completed, the case is tried and adjusted on the master model. The die must have a definite outline. The original impression should have a proper outline of margins, and the impression cup should be fitted under the free gum margin to enable the operator to easily recognize the edges of the prepared cavity.

When the die is ready, and a duplicate is secured in stone, the pattern is carved in the special wax made for this purpose, because it is easier to carve than the regular pink wax used originally for the purpose. This wax is neutral in color and translucent on thin margins and comes in hard and medium working textures. One is cautioned to carve the case so as to duplicate the anatomic form of the other teeth in the mouth rather than to produce entirely new forms out of harmony with the rest of the dental mechanism.

The case is flasked in the lower half of the flask, with stone instead of plaster. If the case is that of an anterior tooth, the labial surface is exposed; if it is a posterior tooth, the buccal surface and 1 mm. of the crest occlusally is exposed to facilitate packing the case. When the stone is set, it is painted with a solution of equal parts of water and water glass; a counter-die is poured in stone, and the halves are separated after the stone is set. Separation is accomplished by boiling out the wax, as in the ordinary denture technic. The residue of wax is washed out thoroughly with carbon tetrachloride and the counter-die is cleaned with hot water. The flasked model is dried and waterglass diluted half and half with water is painted on the stone where the jacket is to be built up. The model is now chilled under cool water and dried. In three minutes, we are ready to pack the case. The other half of the flask is covered with 0.0002 gage tinfoil.

The powder, or polymer, is selected for the case. It is always best to measure out the material either in a tiny cup selected for this purpose or in a copper band, with a finger over one end. The approximate amount of powder necessary is placed in a small jar, such as is used in packaging dental rubber. It is desirable to use three jars: one for the base color, one for the opaque and one for the translucent. Opaque polymer is used to act as a coating for the inner part of the acrylic material to hide the color of the cement, the discoloration of the tooth, metal reenforcements or an iridioplatinum pin, such as is used in anterior corner restorations. The opaque polymer is saturated in the monomer liquid to a very thin stage and more monomer added to this mix than to any other. The jar is closed and allowed to remain for three minutes. The surface of the preparation is painted and allowed to dry for two minutes and then the base color is added. A fine sable brush is excellent for painting on the opaque material.

It is wise for the operator to get the next mix, the base color, ready while waiting for the opaque material to reach the working point; thus a continuous technic can be employed. The acrylic resin selected for the case is packed in the model and shaped approximately to the pattern. The resin is packed to excess to allow for compression. The translucency of the tooth is obtained by using one part base color, two parts clear and an eighth to a fourth part of blue. The blue brings out the true quality of the translucency. This is packed on the area required and the pattern covered with wet cellophane. The other half of the flask is pressed over the preparation and firm pressure applied. The case is opened and the excess cut off. A drop of monomer is applied over the pattern, after removal of the cellophane to examine for color. If the color is satisfactory, the flask is closed and the acrylic processed; if the shade is "off," a drop of monomer is added and some polymer sprinkled where desired. The flask is closed and the processing completed.

In covering both halves of the flask

prior to examining for color, it is best to press the halves together but half way. The flask should be boiled for two minutes and then be completely closed. After it is opened and the excess trimmed off and the color examined, the pattern should assume the correct proportions. Very often, at this point, the incisal shade may have spread a trifle over its proper area or the base color may need a little altering to achieve naturalness. A spot or an opaque area, a crack or a stain may be introduced at this stage or a little pink may be added to the gingival area for a better blend. Care should be exercised to achieve a natural blend of colors instead of having three distinct layers, the gingival, the middle and the incisal. A little of the translucent mix should be applied in the proximal areas and the translucent edge should blend gradually into the main base color instead of being a distinct glassy edge. If a darker shade is used for the base, one should use less of the clear; and if a lighter shade is used, the procedure is reversed.

Pigments and imperfections are added judiciously. This can be overdone, just as is the staining of teeth used in dentures. The imperfections and stains should be added after the case is packed for trial. An area where the correction is to be made is removed and a little of the mix previously prepared of the polymer, monomer and stain added. Often, where there has been a great deal of tissure resorption, it is wise to add some of the pink material to the gingival area to make it blend better with the gum and to camouflage gingival recession. This is done by scooping out a bit of acrylic resin in the area involved, and filling in with the polymer, stained with pink mineral stain.

The case, once completed, is closed. The flask is immersed in boiling water for thirty minutes. If it is a large case, it is kept in the water for forty-five minutes. When completed, it is placed in cold water for fifteen minutes. The flask is opened carefully and the acrylic removed from the stone.

The case, once cured, is finished, regular abrasives, burs and stones being used to perfect the form of the acrylic. When the carving is judged correct and the case has been tried on the master model, polishing is in order. A slow motor, of no more than 1,400 revolutions, is used with pumice and the final shine completed with tin oxide.

It is our opinion, as it is that of all who have really devoted some time to research in the acrylics, that there is a definite place for the material in dentistry. It, however, has not been tried over a sufficiently long time in the mouth to disprove the statements of the critics that it alters in shape and absorbs water. Several have condemned its use because there is no cement available to use with it. We have found that by roughening the surface of the case receiving the cement and that of the tooth in contact with it, we obtain good cementation. Of course, both sides must be coated with the sticky mix of the cement. Firm steady pressure must be used, until the initial set is obtained, and no vibration is used on the case until the next visit. It is very important to slightly clear the bite prior to cementation to allow for the presence of the cementing medium.

The operator must tell the patient that this material, although marking a definite advance in the progress of dentistry, is still in its trial stages, not having stood the test of time.

Porcelain jackets are indicated where the cooperation of the patient is questionable. We are as yet in the dark about the effect of various specimens of saliva on the acrylics over a period of years, the permanence of shades, the spread at the cervix, the wearing through of the jackets, and many other details that only time and research can clarify.

Forty-Ninth and Locust Streets.

ENAMEL HYPOPLASIA (CHRONOLOGIC ENAMEL APLASIA) IN RELATION TO SYSTEMIC DISEASE: A CHRONOLOGIC, MORPHOLOGIC AND ETIOLOGIC CLASSIFICATION

By Bernard G. Sarnat, M.D., D.D.S., M.S., and Isaac Schour, Ph.D., D.D.S., Chicago, Ill.

INTRODUCTION

THE concept that the growing tooth is a biologic recorder of both health and disease has received increasing confirmation from various clinical and experimental studies on the influence of metabolic conditions on tooth development. The growing dental structures, particularly the enamel and dentin, yield accurate, prompt and permanent records of both normal fluctuations and pathologic accentuations of mineral and general metabolism. Fortunately, these records are easily read, by virtue of the orderly and rhythmic growth of these tissues in their daily ringlike succession.

On the basis of the severity and duration of the disturbances, the records may be microscopic or macroscopic. In enamel hypoplasia, the history of systemic disturbances is indelibly recorded by a cessation of ameloblastic activity. A lack of enamel formation is noted in the particular portion of each tooth that is developing during the disease period. With a knowledge of the chronology of tooth development, the record may be assessed on a roentgenographic (unerupted and erupted teeth), clinical and histologic (extracted teeth) basis.

Growing long bones also may serve as recorders of systemic disturbances.[1, 2] Transverse lines of increased density which correspond to the period of altered metabolism can be seen in the roentgenograms. The enamel, however, has certain distinct advantages over bone: (1) it is not subject to resorption and its record is therefore immutable[3]; (2) its chronology of development is more precise, and (3) it can be more readily studied on not only a roentgenographic but also a clinical and histologic basis.

The purpose of this clinical investigation was to study the chronologic incidence, the morphologic pattern and the possible etiologic factors of enamel hypoplasia in relation to systemic disease.

REVIEW OF LITERATURE

One of the earliest references to enamel defects of the teeth dates from 1743, when Bunon[4] described "erosion" of teeth due to rickets, measles and scurvy (Table 1). It was not until 1785 that Sanchez[4] reported dental alteration in relation to syphilis. In 1858, Hutch-

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Portion of an investigation adjudged co-winner of the J. A. Capps Prize (1940) of the Institute of Medicine, Chicago, for Medical Research.

Photographic and roentgenographic phases of this work carried out with the assistance of Miss Edna Anderson.

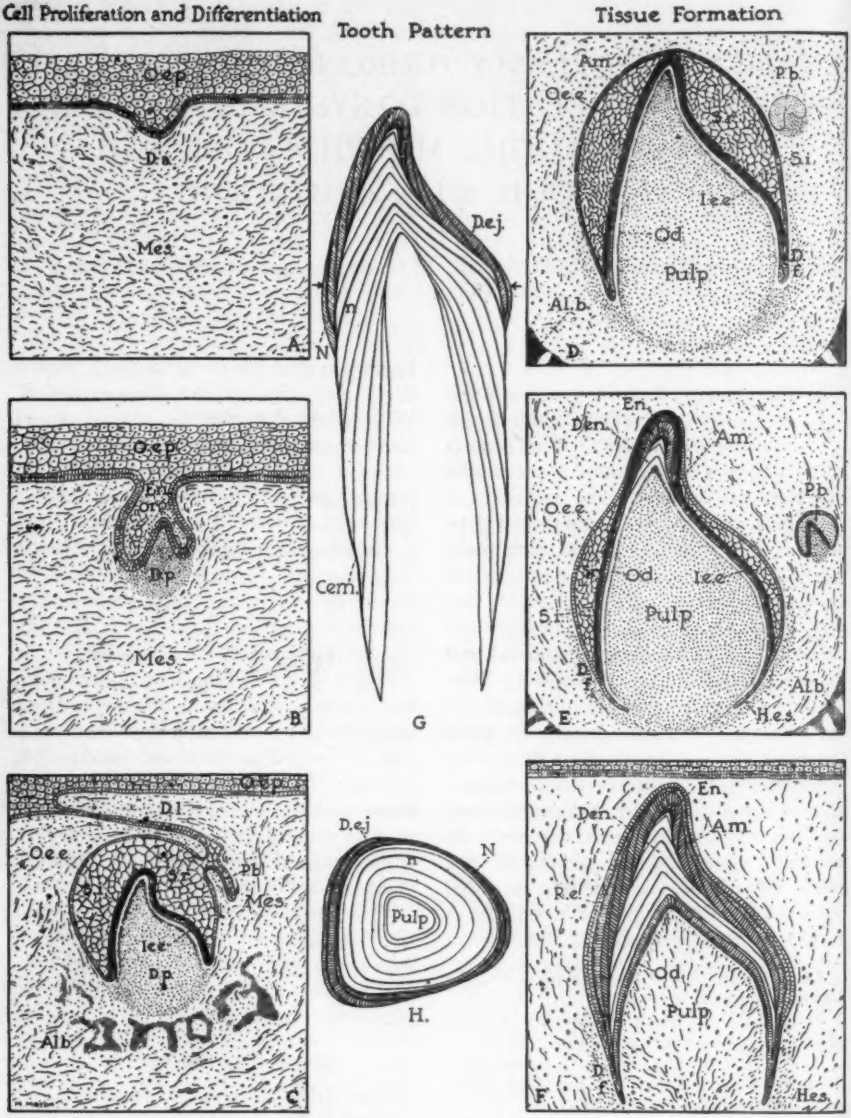


Fig. 1.—Embryology and growth pattern of human deciduous central incisor (Schour and Poncher, in Am. J. Dis. Child., 1937).

inson[5] believed certain dental findings to be characteristic of hereditary syphilis. Gottlieb[6] described enamel hypoplasia in rickets, while Parrot[4] considered the combination of syphilis and rickets as the principal etiologic agent. Heredity,[7] toxicity,[4] tetany[8] and vitamin-A deficiency[9] are other causative factors that

have been reported. Berten,[10] Black[11] and Calteux,[12] however, placed the etiology on a much broader basis, believing that any disturbance severe enough to interfere seriously with nutrition would be reflected in the tooth.

The term "erosion" was first used by the French. Zsigmondy,[13] in 1893, advocated "enamel hypoplasia," which has been the most generally accepted term. Black[11] used "atrophy" and "contemporaneous accretional dystrophy" in addition to "enamel hypoplasia," but he was not entirely satisfied with the terms (Table 1).

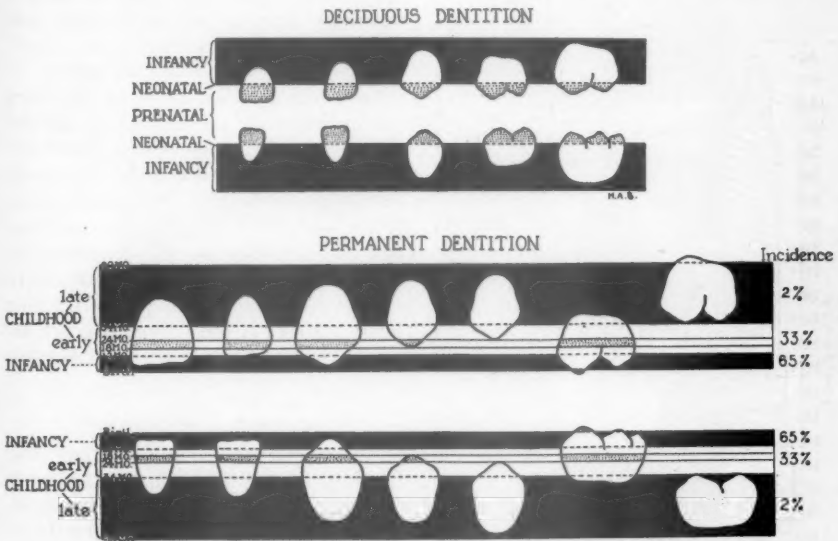


Fig. 2 Characteristic levels at which chronologic enamel aplasia occurs.

SUMMARY OF TOOTH DEVELOPMENT

A concept of the orderly and rhythmic growth of enamel and dentin in ringlike succession may be obtained best by a brief review of tooth development. For this purpose, the development of the deciduous upper central incisor will be described. (Fig. 1.)

(A) Between the sixth and seventh weeks of intra-uterine life, an inward proliferation of the oral epithelium (O. ep.) occurs. This is the dental anlage (D.a.). (B) Cellular proliferation continues until soon an invagination takes place and the connective tissue which borders the invaginated epithelial portion condenses and forms the dental papilla (D.p.), the primordium of the dentin and pulp. (C) The enamel organ (En. Org.) which arises from the invaginated epithelium is comprised of an inner enamel epithelium (I.e.e.) and an outer enamel epithelium (O.e.e.), between which are the stellate reticulum (S.r.) and stratum intermedium (S.i.). (D) The inner enamel epithelium gives rise to ameloblasts (Am.), and the adjacent connective tissue of the dental papilla gives rise to odontoblasts (Od.). These two layers of cells are in contact at the dentino-enamel junction. At about the fifth month *in utero*, a microscopic cusp of dentin (Den.) is formed, which is soon followed by a corresponding amount of enamel (En.). (E) With this formation initiated, there is a syn-

chronous recession of the ameloblasts and odontoblasts from each other. Incremental layers of enamel are apposed, one on top of another until the cusp is fully formed. (F) Subsequent layers are apposed at the sides until the crown is complete. For each layer of enamel that is apposed, one outside another, a corresponding layer of dentin is apposed, one within another. (G) After enamel formation has ceased, dentin formation continues, for completion of the root.

The occurrence of a sufficiently severe

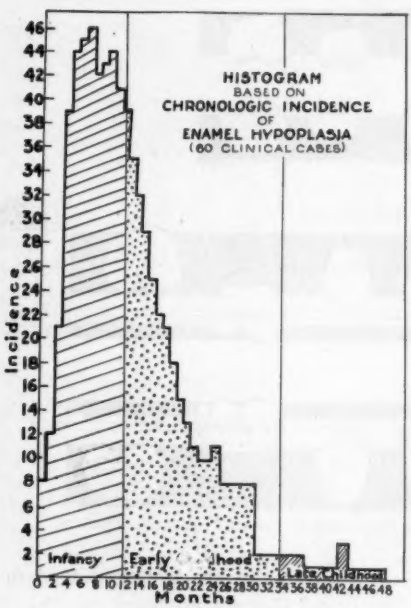


Figure 3.

systemic disturbance at any time during the appositional development of the crown may arrest the activity of the group of functional ameloblasts. Their life is then terminated prematurely and the resulting enamel rods will be shorter than the normal. This will be expressed on the crown of the tooth as an area lacking in enamel.

CHRONOLOGY OF TOOTH DEVELOPMENT

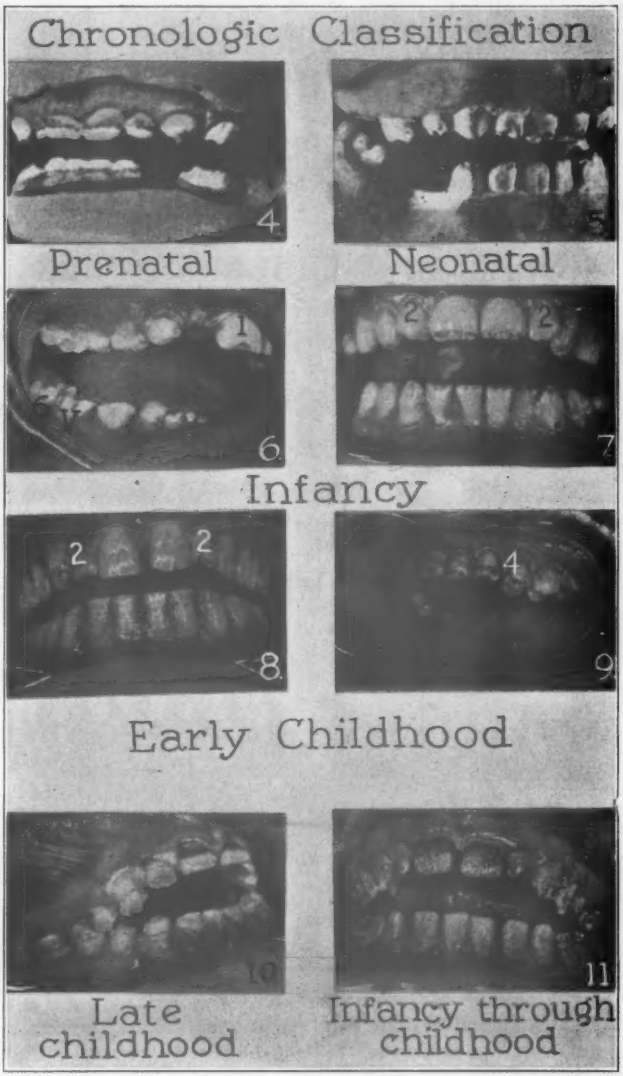
With certain variations in the morphologic pattern, the same developmental process as described for the deciduous incisor is initiated at definite intervals for the formation and calcification of the various teeth in both dentitions. Table 2, which was prepared for an earlier report,[14] shows the groups of teeth active in enamel formation in each developmental period. This is based upon our present available knowledge of enamel formation.[15, 16] (The complete findings of Diamond and Weinmann[32] on enamel formation were not available at the time of this study. Further histologic analysis will increase our understanding of enamel hypoplasia.) Figure 2 illustrates the approximate chronology of the development of enamel in the deciduous and the permanent dentition. The process begins at about the fourth month *in utero,* and the formation and calcification of enamel are usually completed by the seventh year, except for the third molar. Systemic disease will affect only those portions of the crowns that are being formed and calcified at that particular time.

MATERIAL AND METHODS

A. *Material.*—A clinical study was made of sixty patients chosen at random whose teeth showed enamel hypoplasia. (Patients were referred from the dental clinics of the University of Illinois College of Dentistry, the Cook County Dental Clinic and the Dental Division of the Chicago Board of Health through the dentists assigned to examine the children of the Chicago Public Schools by courtesy of Carl Greenwald.) In addition, more than 300 teeth showing hypoplastic defects of the enamel were obtained from various extraction clinics and studied.

B. *Methods.*—The following methods were employed:

1. Medical history: A detailed history was obtained with special emphasis on



Figs. 4-11.—Chronologic enamel aplasia which occurred during various growth periods and groups of teeth affected. The level of the enamel defect is progressively toward the gingival aspect with the later time of occurrence. (Compare Fig. 2.)

Fig. 4.—Models of deciduous dentition with prenatal enamel aplasia (Wolfe, in Am. J. Dis. Child., 1935).

Fig. 5.—Models of deciduous dentition of patient of premature birth with neonatal enamel aplasia (Kronfeld and Schour, in THE JOURNAL, 1939).

Fig. 6.—Early-infancy enamel aplasia. The deciduous (V) and permanent (1, 6) teeth are affected. (Compare Fig. 18.)

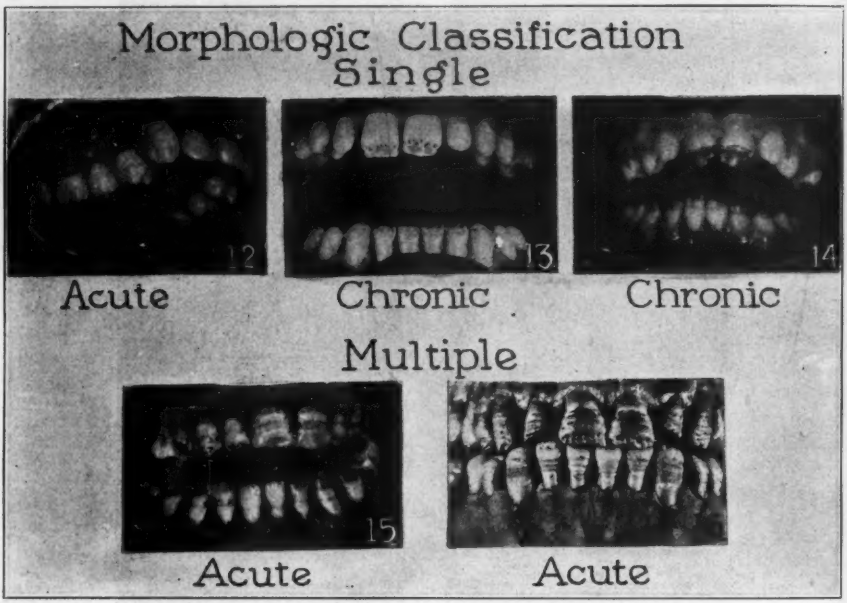
Fig. 7.—Infancy enamel aplasia of permanent teeth. All the anterior (except the upper lateral incisors [2]) and the first molar teeth are affected. (Compare Fig. 19.)

Fig. 8.—Early-childhood enamel aplasia. The upper lateral incisors (2), in addition to all the anterior and first molar teeth, are affected. (Compare Fig. 20.)

Fig. 9.—Early-childhood enamel aplasia. The bicuspids (4), in addition to all the anterior and first molar teeth, are affected. (Compare Fig. 21.)

Fig. 10.—Late-childhood enamel aplasia. Every tooth except the third molar is affected. (Compare Fig. 22.)

Fig. 11.—Chronologic enamel aplasia which began in early infancy and lasted through the late-childhood period. The coronal portions of all the teeth present are affected.



Figs. 12-16.—Various morphologic types of enamel hypoplasia.

Fig. 12.—Narrow single enamel hypoplasia. This is characteristic of the single occurrence of an acute disease.

Figs. 13 and 14.—Wide single enamel hypoplasia. These are characteristic of the single occurrence of a chronic disease.

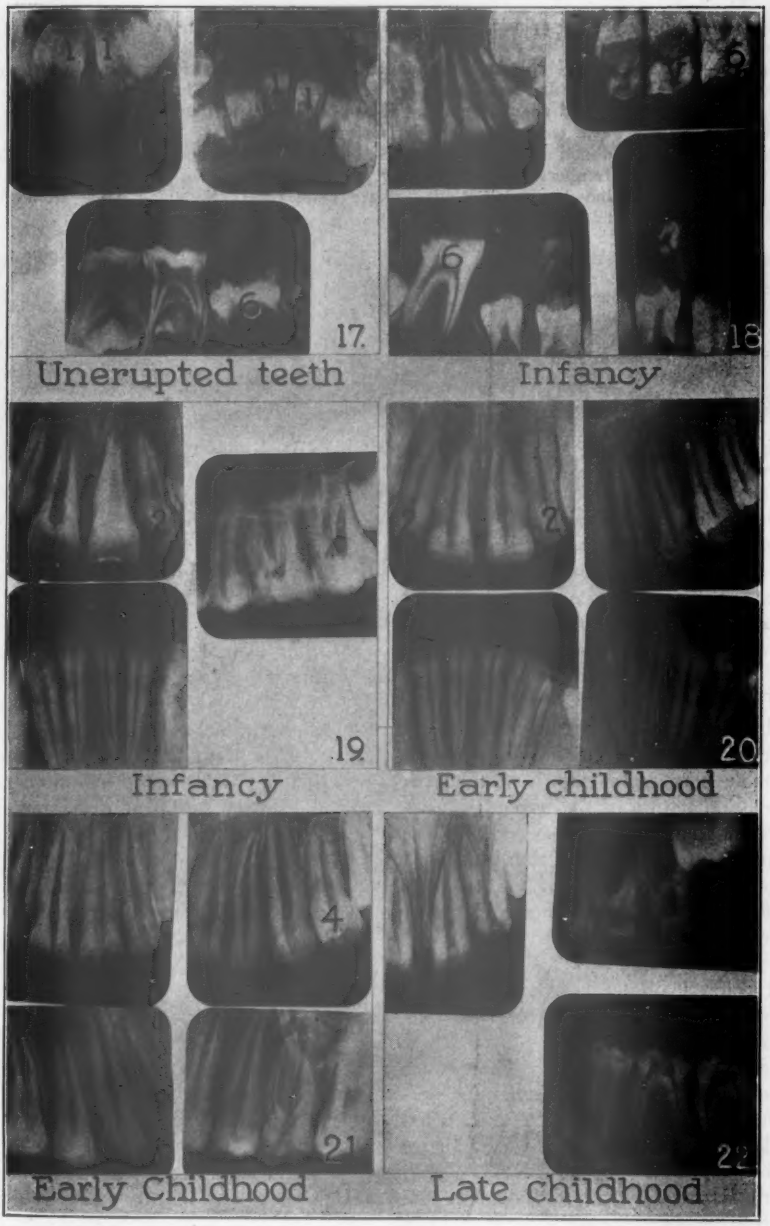
Figs. 15 and 16.—Multiple enamel hypoplasia; characteristic of recurrent periods of disturbed metabolism.

the infancy and childhood periods. In only a few instances was it possible to study written records made during the early life of the patient.

Since one of the primary purposes of this investigation was to study the etiology of enamel defects, a number of cases were eliminated because adequate histories were not available. Thus, out of an original group of more than 100 patients showing hypoplastic enamel defects, only sixty were finally studied. Each patient of the latter group was restudied approximately one year later for the purpose of revaluating the findings and rechecking the history. This precaution was taken because it was fully realized that the history was, as might be expected, incomplete.

2. Dental analysis: The dental examination consisted of:

(a) A gross examination with dental



Figs. 17-22.—Chronologic enamel aplasia which occurred during various growth periods.

Fig. 17.—Unerupted permanent teeth with infancy enamel hypoplasia. The patient had rickets. 1, central incisors; 6, first molar. (Courtesy Elsie Gerlach, Children's Clinic, College of Dentistry, University of Illinois.)

Fig. 18.—Infancy enamel aplasia. The deciduous (V) and permanent (1, 6) teeth are affected. (Compare Fig. 6.)

Fig. 19.—Infancy enamel aplasia of permanent teeth. All the anterior (except the upper lateral incisors [2]) and the first molar teeth are affected. (Compare Fig. 7.)

Fig. 20.—Early-childhood enamel aplasia. The upper lateral incisors (2), in addition to all the anterior and first molar teeth, are affected. (Compare Fig. 8.)

Fig. 21.—Early-childhood enamel aplasia. The bicuspids (4), in addition to all the anterior and first molar teeth, are affected. (Compare Fig. 9.)

Fig. 22.—Late-childhood enamel aplasia. Every tooth except the third molar is affected. 7, permanent second molar. (Compare Fig. 10.)

Figs. 23-25.—Cases of enamel hypoplasia presenting special problems in restorative dentistry because of lack of esthetic values and function.

explorer and mouth mirror: A detailed record was made of the particular teeth involved and of the exact position and extent of the aplastic enamel defects and their morphologic characteristics. The approximate chronology of each defect was determined and recorded by the use of Table 2 and Figure 2.

(b) Intra-oral roentgenograms: These were taken of each patient. They offered valuable permanent records of the incidence and nature of the hypoplastic defects in the unerupted, as well as the erupted teeth, and, in addition, permitted a more complete study of the presence or absence of teeth and the incidence of caries and periapical involvements.

(c) Photographs: Black-and-white and colored photographs of the teeth were taken of a selected group for permanent record.

(d) Plaster impressions: These were obtained in a number of cases for permanent record and for more detailed studies of the defects and the incidence of malocclusion.

(e) Extracted teeth: The extracted teeth were first studied with the naked eye and the hand lens. Roentgenograms and photographs were taken of a selected number.

FINDINGS

The findings will be described under the following main divisions: A. Chronologic Incidence. B. Morphologic Characteristics. C. Possible Etiologic Factors. D. Other Dental Findings. E. General Findings.

A. *Chronologic Incidence.*—A charting of the time of occurrence of the enamel hypoplasia found in each patient revealed an orderly distribution that varied with the following developmental periods of the patient (Fig. 3):

1. Prenatal period: Hypoplastic defects of the enamel formed during the prenatal period were not found (Table 2, Figs. 2, 4).

2. Neonatal period: No instance of neonatal hypoplasia was found in this study (Table 2, Figs. 2, 5).

3. Infancy period (birth approximately to end of first year): Two-thirds of the hypoplastic disturbances occurred during this period (Table 2, Figs. 2, 6, 7, 18, 19).

4. Early childhood period (approximately 13 to 34 months): Nearly one-third of the enamel hypoplasia was found in the portions of the teeth formed during this period. Thus, the upper lateral incisors and the first and second bi-

cuspids, which begin to form during this period, are also affected (Table 2, Figs. 2, 8, 9, 20, 21).

5. Late childhood period (approximately 35 to 80 months): Less than 2 per cent of the enamel defects originated in this period and involved the second molars (Table 2, Figs. 2, 10, 11, 22). In no instance was enamel hypoplasia found in the third molars.

Thus, the time of occurrence of systemic disease determines which teeth will be affected. As to the frequency with which the various teeth were affected, in fifty-nine of the sixty patients, the first

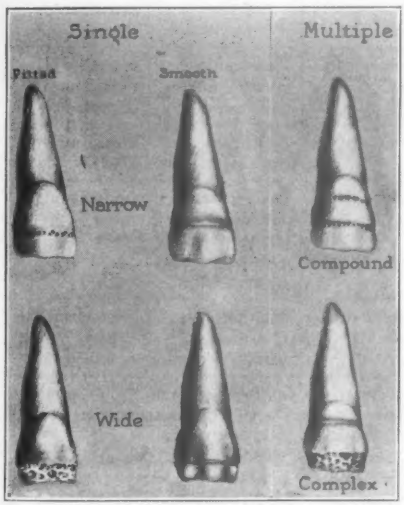


Fig. 26.—Morphologic classification of enamel hypoplasia (chronologic enamel aplasia).

permanent molars evidenced disturbance (in one patient, the period of enamel aplasia occurred after the crown was completed). The permanent upper central incisor and cuspid and the lower central and lateral incisor and cuspid were invariably affected. The permanent upper lateral incisor evidenced disturbance in thirty-seven instances, the first bicuspid in six, the second bicuspid in four, the second permanent molar in two and the third molar is no instance.

Any given enamel hypoplasia may occur during part of one of the above developmental periods, as in the case of an acute disturbance, or it may extend through an entire period or periods. In the latter case, the etiologic disturbance is chronic. The approximate duration of the periods, but not the time of occurrence of the enamel hypoplasia on the sixty cases studied clinically, is shown in Table 3. The total number of incidences is greater than the number of patients studied because, in three patients, enamel hypoplasia recurred after a normal period of development.

B. *Morphologic Characteristics.* — A gross examination of the hypoplastic defects of the enamel in the sixty patients and the extracted teeth showed the following general types:

1. Single zones of missing enamel:
   a. Narrow defects:
      (1) Pitted.
      (2) Smooth (Fig. 12).
   b. Wide defects:
      (1) Pitted (Fig. 13).
      (2) Smooth (Fig. 14).
2. Multiple zones of missing enamel (Figs. 15, 16).

Although a morphologic description of narrow or wide zones of defective enamel is given, it should be realized that this is related to both the chronologic period and the particular incremental pattern. Usually, a narrow zone is indicative of enamel formation affected for a shorter time (acute); a wide zone, of enamel formation affected for a longer time (chronic). Multiple zones indicate that enamel formation was probably affected on more than one occasion.

C. *Possible Etiologic Factors.*—In each case of enamel hypoplasia, an attempt was made to correlate the approximate time of occurrence of the enamel defects with the history of the patient's health at that particular time (Table 4). No specific etiology was found. Rickets was

TABLE 1.—BRIEF HISTORICAL REVIEW OF ENAMEL HYPOPLASIA

Author	Date of Publication	Terminology	Classification According to		
			Chronology	Morphology	Etiology
Bunon	1743	Erosion		Sulciform, cup-shaped, etc.	Rickets, measles, scurvey
Sanchez	1785	Premature caries (black decay of teeth)			Hereditary syphilis
Hutchinson	1858	"Notched incisor"	"Infancy"	Notched or crescent incisor	Hereditary syphilis
Zsigmondy	1893	Congenital defects of enamel, enamel hypoplasia		Furrows, pits	
Berten	1895	Enamel hypoplasia, congenital enamel defects, erosion	Mainly first year of life	Diversified	Nutritional disturbances
Black	1904	Atrophy, hypoplasia, contemporaneous accretional dystrophy	First five years of life	Pitted groove, inverted finger-nail scar, etc.	Serious nutritional disturbances
Cavallaro*	1908	Dental erosion	Intra-uterine	Pitted, sulcate, cup-shaped, etc.	Hereditary syphilis
Karnosh†	1926	Enamel hypoplasia	Early childhood	Honeycomb, sleeve-cuff, terrace type, corn-kernel, corrugated form	Nutritional upset
Calteux	1934	Enamel hypoplasia	Mainly first year of life	Multifarious, pits, grooves, band	Disturbances in calcium metabolism
Findings in this report		Chronologic enamel aplasia	Approximately: 65% infancy 33% early childhood 2% late childhood	a. Single zones of enamel aplasia 1. Narrow 2. Wide b. Multiple zones of enamel aplasia	Non-specific, severe metabolic upset

*Cavallaro, Joseph: Reference 4. Syphilis in Relations to Dentition. *D. Cosmos,* 50:1325, December, 1908.

†Karnosh, Louis J.: Histopathology of Syphilitic Hypoplasia of the Teeth. *Arch. Derm. & Syph.,* 13:25, January, 1926.

the most common cause, whereas the exanthematous diseases were relatively unimportant. In more than 50 per cent of the patients studied, no possible etiologic factor could be determined.

Measles: Fifty of the sixty patients had had measles. Of these, only six (Nos. 3, 5, 10, 15, 17 and 27) had the disease during the period when enamel formation was affected. It is significant to note, however, that, in each of these six cases, the enamel aplasia had been present at least three months before and ended at least two months after the occurrence of measles. Measles is an acute disease, whereas the disturbances recorded in the teeth in each of these six cases lasted for at least eight months.

Scarlet fever: Eighteen patients of this group had had scarlet fever. In no instance

was a correlation found between the time of occurrence of the enamel hypoplasia and the systemic disease.

Chickenpox: This disease had occurred in twenty-nine of the patients. In only two cases (Nos. 4 and 17) was chickenpox present during the period of enamel aplasia. In the former, the enamel disturbance was present from about birth to thirty months and the chickenpox occurred during the thirteenth month. In the latter, the enamel was disturbed from about the third to the thirty-sixth month, whereas the chickenpox occurred during the thirty-sixth month.

Whooping cough: A history of whooping cough was obtained from thirty-nine patients. In patients 3, 4, 7, 15 and 17, the disease was present during the period of disturbed enamel formation, which began, however, before and lasted at least eight months after the whooping cough. Fifteen months was the shortest period of enamel aplasia. Case 11 is worthy of note since the whooping cough was present from the twenty-fourth to the twenty-seventh month; whereas the period of enamel aplasia was from approximately the twenty-seventh to the thirtieth month.

Diphtheria: Nine patients of this group had had diphtheria. Patient 13 had diphtheria at 10 months and disturbed enamel formation from 3 to 15 months. Patient 17 had diphtheria at 27 months. The period of enamel aplasia was from 3 to 36 months. There was no chronologic correlation in the remaining seven patients.

Pneumonia: The simultaneous occurrence of both enamel hypoplasia and pneumonia was found in patients 10, 13, 17, 23 and 28. In each instance, however, the pneumonia began at least seven months after the enamel aplasia. In four other cases, the pneumonia and enamel hypoplasia did not occur at the same time.

Rickets: In ten of these patients, physicians determined that rickets had been present during the infancy and early-childhood periods. Since rickets is a chronic disease, the possibility of a correlation between the rachitic condition in Cases 1 to 10 inclusive and the period of chronic enamel aplasia must be considered. In several of the patients, the defective enamel antedates the clinical history of the onset of the disturbance by a few months.

Convulsions: A history of convulsions was obtained from twelve patients. In nine of these, the convulsions occurred during the period of disturbed enamel formation. The etiology of the convulsions is not known. It is possible that the convulsions are only a manifestation of a subclinical disease that was present during the period of enamel aplasia.

Vomiting: Five of the sixty patients had had periods of severe vomiting. In two in-

Table 2.—Groups of Teeth, Deciduous and Permanent, Active in Enamel Formation in Each Developmental Period

Growth period	Approximate chronologic period	Teeth which begin enamel formation*	Teeth which complete enamel formation	Teeth undergoing enamel formation
Prenatal	4 months in utero to birth	I II III IV V / I II III IV V		I II III IV V / I II III IV V
Neonatal	Birth to 2 weeks	6 / 6		I II III IV V 6 / I II III IV V 6
Infancy	3 weeks to 12 months	1 3 / 123	I II III IV V / I II III IV V	I II III IV V 1 36 / I II III IV V 1236
Early childhood	13 months to 19 months	2		1236 / 1236
	20 months to 24 months	4 / 4		12346 / 12346
	25 months to 34 months	5 / 5	6 / 6	123456 / 123456
Late childhood	35 months to 80 months	7 / 7		123457 / 123457

*Deciduous teeth: I, central incisor; II, lateral incisor; III, cuspid (canine); IV, first molar; V, second molar. Permanent teeth: 1, central incisor; 2, lateral incisor; 3, cuspid (canine); 4, first bicuspid; 5, second bicuspid; 6, first molar; 7, second molar.

stances, the vomiting occurred during a period of disturbance in enamel formation.

Diarrhea: A history of severe diarrhea was obtained in three instances.

Other Diseases: Other questions in the history pertaining to smallpox, mumps, influenza, bronchitis, congenital syphilis, operations, injuries and allergies brought out no specific correlation with enamel hypoplasia.

Nutritional History: Thirty-four of the patients were being fed on breast milk; nineteen were given cod-liver oil and seventeen were given some form of vitamin C during the period of enamel aplasia. There was no apparent correlation between these factors and the enamel hypoplasia.

Idiopathic Data: In the majority of patients (51 per cent), no possible correlation could be made between the record of defective enamel in the teeth and the medical history.

D. *Other Dental Findings.* — Other dental findings were as follows:

Roentgenographic characteristics: Roentgenograms of unerupted (Fig. 17) and erupted teeth (Figs. 18-22) with enamel hypoplasia show characteristic radiolucent areas where there has been a lack of enamel formation. This corresponds to the time of the systemic disturbance. Thus, with a knowledge of the chronology of tooth formation, the approximate time of the metabolic upset can be determined readily prior to eruption, by roentgenograms.

Missing teeth: In this series of patients, whose ages varied from 7 to 31 years (Table 5), 16 per cent of the first permanent molars were missing. This resulted in a shifting of the remaining teeth in a number of instances.

Esthetics: Patients with either a chronic or a multiple-acute type of enamel hypoplasia involving wide areas on a number of teeth are found in several instances. Not infrequently, an attractive person is found to talk and smile in a constrained manner, as if making an effort to hide the teeth. Upon oral examination, the reason is soon apparent. (Figs. 13, 16, 23-25.)

E. *General Findings.* — The general findings were as follows:

Of the 60 patients examined, thirty-seven were male and twenty-three were female. There were forty-five Caucasians, thirteen Negroes and two Mongolians. Forty-three patients spent their infancy and early-childhood periods in Chicago and eleven in the United States outside of Chicago. Of the six remaining, two spent these periods in Russia, and one each in Germany, Hungary, Poland and Scotland. The age distribution ranged from 7 to 31 years (Table 5). The following nationalities were represented: Chinese, Czech, Danish, German, Greek, Hungarian, Irish, Italian, Jewish, Lithuanian, Mexican, Polish, Russian, Scottish and Swedish. In two families, three siblings were found to have enamel hypoplasia; and in ten families, two siblings had it. In the remaining thirty-four families, only one person was found to be affected. In no instance was a parent found to have a similar condition. In a set of fraternal twins, one was affected and the other was not.

Physical findings gave no indication of congenital syphilis. The serologic findings were negative for syphilis in the blood samples of thirty patients chosen at random from the total group of sixty.

(To be continued)

TABLE 3.—SIXTY-FOUR INCIDENCES OF ENAMEL HYPOPLASIA ARRANGED ACCORDING TO DURATION

Number of cases	11	2	1	1	2	1	3	3	6	1	5	6	3	6	1	2	2	1	1	1	1	1	1	1
Duration months	1*	2	3	4	5	6	7	8	9	10	11	12	14	15	17	18	19	22	24	26	27	29	30	33	48

*Areas of defective enamel which were about 1 mm. wide were arbitrarily designated as of one month's duration, although the actual disease period may have been less.

TIME REQUIRED TO CAST GOLD BY CENTRIFUGAL FORCE

By RAYMOND E. MYERS, D.D.S., B.S., Louisville, Ky.

IN a recent paper,[1] Pfeiffer and I determined the effect of varying conditions on the time required to cast gold under air pressure and pointed out the importance of studying casting time, as follows:

The difficulty of successfully producing castings of relatively extended areas in proportion to their thickness may be explained in part by the failure of the metal to stay molten sufficiently long to complete the casting, unless it is superheated to a degree where its physical properties are detrimentally affected. Under customary conditions of dental casting, the temperature of the walls of the pattern chamber is below that of the molten metal at the instant that it is injected into the mold. Consequently, there is always a tendency for the advancing portion of the metal to congeal before it reaches the farthest or thinnest recesses of the mold cavity. It is evident, therefore, that the rapidity with which the molten metal enters and spreads throughout the pattern chamber is of considerable importance in successful casting practice.

Reference was made in the same paper to investigations by Souder[2] and by Herbert and Thompson,[3] who made measurements of casting time under air pressure and steam pressure, respectively.

To my knowledge, no attempt has yet been made to measure the time required to cast gold on centrifugal machines and to compare the effective force produced by this method of casting with that of fluid pressure.

From the Laboratory for Physical Research, University of Louisville, School of Dentistry.

Read at the Nineteenth General Meeting of the International Association for Dental Research, St. Louis, Mo., March 16, 1941.

The popularity of centrifugal machines for dental casting and the dissimilarity of the physical principles associated with centrifugal and air pressure casting emphasize the need for the present investigation.

Since this work is a continuation of the study by Pfeiffer and me, it is recommended that the reader refer to the previous paper for an understanding of the entire project.

METHOD

To measure the rapidity with which this casting operation is effected will necessitate a determination of the time interval between the start of rotation of the cross-bar of the machine and the instant that the pattern chamber is completely filled with molten metal. In the present investigation, this interim was measured by breaking an electrical circuit simultaneously with the start of rotation of the cross-bar of the machine and making the circuit again by contact of the molten metal with platinum-iridium wires embedded in the pattern chamber. These break and make impulses were transferred through the writing point of a signal magnet and recorded on a revolving smoked drum. The interval was measured by tracing the vibrations of a writing point attached to one arm of an electrical tuning-fork, across the recorded impulses of the signal magnet, and dividing the number of vibrations between the break and make impulses by the known frequency of the fork. Thus, these measurements could be made accurately and simply without

departing in the least from the conditions of ordinary casting practice.

APPARATUS

1. *General Description.*—The apparatus viewed as a whole is shown in Figure 1. Its various parts are graphically represented in Figure 2. It consists of five units designated, from right to left, as follows: (1) a centrifugal casting machine provided with means for making an electrical circuit during revolutions of the cross-bar, and a starting lever to break the circuit with release of the cross-bar; (2) dry-cell batteries to supply energy for the break and make circuit; (3) a ring stand supporting a horizontally placed signal magnet with an attached writing point; (4) an electrically operated kymograph, and (5) an electrical tuning fork driven by a 6-volt storage battery and provided with a writing point.

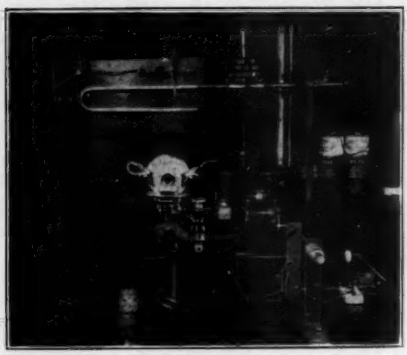


Fig. 1.—General view of apparatus used in investigation.

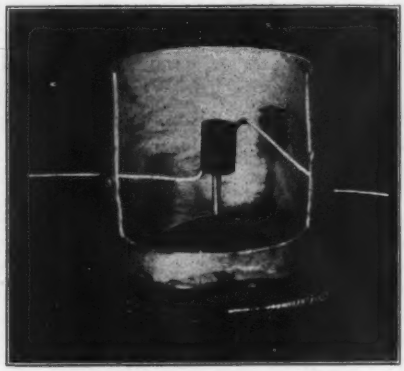


Fig. 3.—Prepared pattern ready for investing. The flask is sectioned to show the interior.

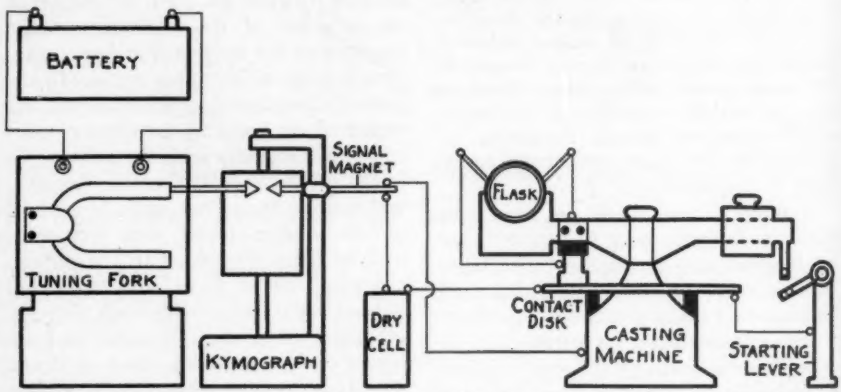


Fig. 2.—Diagrammatic representation (not to scale) of apparatus, including wiring diagram of break and make circuit.

2. *The Molds.*—A prepared pattern ready for investing is shown in Figure 3. The pattern was carved from inlay wax to the desired dimensions and attached to a metal sprue former. This

was in turn mounted on a crucible former and adjusted to form a sprue of the desired length. Two pieces of 18-gage (B & S) wax wire, each 3 mm. in length, were prepared to serve as contact tips. One tip was attached to the peripheral border of the bottom of the wax pattern and the other at the peripheral border of the top on the opposite side. A stainless steel flask provided with a small hole on each side was placed on the crucible former and sealed to it with sticky wax. Platinum-iridium wires (22-gage B & S) were passed through the holes in the flask and sealed to the upper and lower contact tips, respectively.

The investment material used in all of the tests was an American Dental Association specification type. It was mixed with a water:powder ratio of 0.30, mechanically spatulated and vibrated into the flasks.

The molds were heated in an electric furnace to 650° C.

The flasks were always placed on the casting machine in such a manner that the contact tip attached to the top of the wax pattern would be in the uppermost position. This placement in turn caused the contact tip on the bottom of the wax pattern to be in the lowest position. This design was adopted to prevent a contact of the tips with molten gold before the pattern chamber was completely filled.

3. *The Casting Machine.*—Figure 1 shows a commercial centrifugal casting machine with the necessary mechanical alterations and attachments to meet the requirements of the investigation. A brass disk is placed below the cross-bar and insulated from the base of the machine by means of wood posts. In contact with the disk is a carbon brush attached with insulation to the cross-bar and adjusted to ride the disk when the cross-bar revolves. The terminal clamps shown on each side of the fire-clay crucible are attached to wires which communicate with the cross-bar of the machine and the carbon brush, respectively. This arrangement allows an electric circuit to be maintained while the machine revolves. Just behind the counterweight is an extension rod to engage a starting lever after the spring of the machine is wound. The starting lever has an electrical attachment which breaks the circuit simultaneously with the "take-off" of the machine.

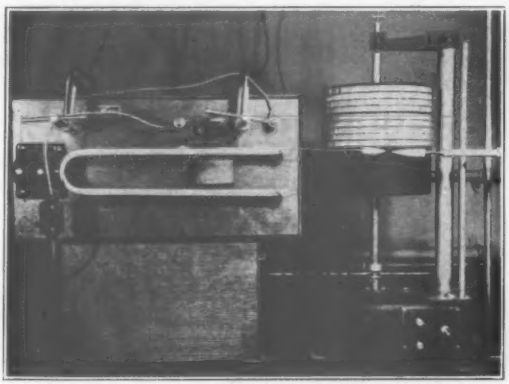


Fig. 4.—Equipment for making time-interval measurements. The electrically operated tuning fork is shown on the left and the motor kymograph on the right. The two writing points in front of the smoked drum are attached to the tuning work and signal magnet, respectively.

4. *Equipment for Measuring Time.*—The time interval measurements were

made with an electrically operated tuning fork and motor kymograph. (Fig. 4.) Below the white bands on the smoked drum of the kymograph are two writing points, one attached to the upper arm of the tuning fork and the other to a signal magnet. The tuning fork, driven by a 6-volt storage battery, has a frequency of sixty-three vibrations per second, and the tracings recorded on the drum of the kymograph can easily be counted with the aid of a small lens. A typical tracing is shown in Figure 5. Since the drum of the kymograph revolves in a clockwise direction, the readings are made by counting the number of recorded vibrations beginning with the break in the upper line on the left and ending with the break in the lower line on the right. It will be noted in the illustration that the recorded vibrations of the tuning fork are sufficiently separated that the tracings of the signal magnet can be read between two vibration lines. Since the distance from one line to another corresponds to one sixty-third, or 0.0158, second, half the distance is equivalent to one one-hundred-twenty-sixth, or 0.008, second. In all tests, the number of recorded vibrations were divided by sixty-three and the value rounded off to the third decimal place. The time-measuring equipment was mounted on a separate table to prevent any vibration produced by the casting machine from disturbing the tracings.

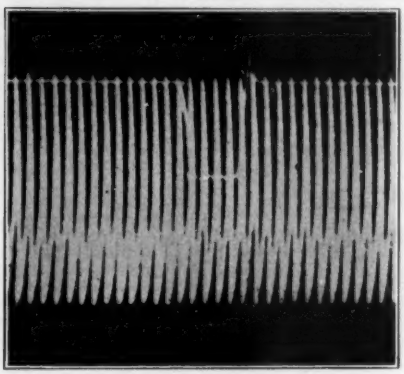


Fig. 5.—Typical tracing, enlarged. The actual tracings were small enough to require the aid of a small lens for accurate counting. The interim of this recording is 4.5 vibrations, or 0.071 second.

5. *The Electrical Circuit.*—The wiring diagram of the break and make circuit in relation to the various units of equipment is diagrammatically represented in Figure 2.

PROCEDURE

The cross-bar of the machine was given the required number of turns to wind the spring and held in position with the starting lever. A prepared flask was removed from the electric furnace and placed on the machine. The terminal clamps of the electric circuit were then attached to the platinum-iridium wires projecting from each side of the flask. A specified amount of casting gold, which had been previously heated to redness on a charcoal block, was placed in the fire-clay crucible. (The gold alloy used throughout the course of the investigation was an American Dental Association specification type with the following approximate formula: gold, 90 per cent; copper, 7 per cent; platinum, 1 per cent, and silver, 2 per cent.) The metal was immediately brought to the proper casting temperature by means of an oxygen and gas blowpipe. Just prior to releasing the cross-bar of the machine, the switch on the table was closed, and thus the electrical circuit was completed and the writing point of the signal magnet moved up. At the same instant, the tuning fork was energized and the motor of the kymograph turned on; which caused the drum to revolve. The starting lever was quickly turned, and the cross-bar of the machine thus allowed to revolve and the entry of the molten metal into the mold effected by centrifugal force. Simultaneously with the release

of the cross-bar, the circuit was broken and the writing point of the signal magnet allowed to drop.

The filling of the pattern chamber with molten metal effected contact between the two platinum-iridium wires embedded in the mold and the circuit was again completed, the writing point of the signal magnet then moving up. The time interval was determined by counting the number of vibrations and dividing this value by the frequency of the tuning fork.

gages by centrifugal force produced with varying winds of the machine. The results are given in Table 1.

The patterns were carved from inlay wax to the form of right cylinders measuring 6.4 mm. in diameter and 10 mm. in height. Two contact tips were attached to each pattern in the manner previously described.

The sprue formers were round metal pins, the gages of which were checked with a micrometer caliper. In each case, the pin was attached to the circular base of the pattern and adjusted in position on the crucible former to provide a sprue 8 mm. in length. Sprue formers of 11, 14 and 17 gage (B&S) were selected because the extremes do not exceed the range that is consistent with accepted casting practice and the cross-sectional areas of those respective gages progres-

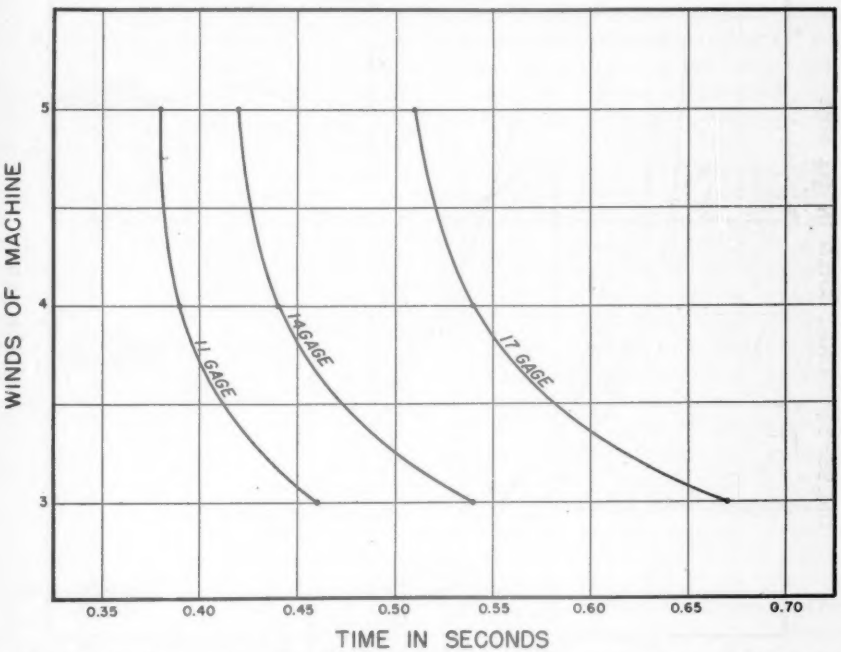


Fig. 6.—Graphic representation of effect of centrifugal force produced with varying winds of machine on time required to cast gold through sprues of varying gages.

RESULTS

1. *Effect of Magnitude of Centrifugal Force and Gage of Sprue on Time Required to Cast Gold.*—The first series of forty-five experiments was performed in an effort to measure the time required to cast gold through sprues of varying

sively decrease by 50 per cent. The gage numbers used throughout this paper refer to Brown and Sharpe or American Standard Wire gages.

It is, of course, evident that the stated values for the cross-sectional areas of the sprues are slightly in error owing to discrepancies due to the removal of the pins and dimensional changes of the investment material during heating and cooling. No attempt was made to avoid this discrepancy since it was believed that an approximate measure of the time required to cast gold under customary conditions would be of greater practical value than a more accurate measure under abnormal conditions.

The average values for the time required to cast gold through 11-gage, 14-gage and 17-gage sprues by centrifugal force produced with 3, 4 and 5 winds of the machine are represented graphically in Figures 6 and 7. Referring to these graphs, it may be observed that the time with sprues of all gages is appreciably increased when the force is reduced to 3 winds and that the time with forces produced by varying winds is appreciably increased when the size of the sprue is reduced to 17 gage.

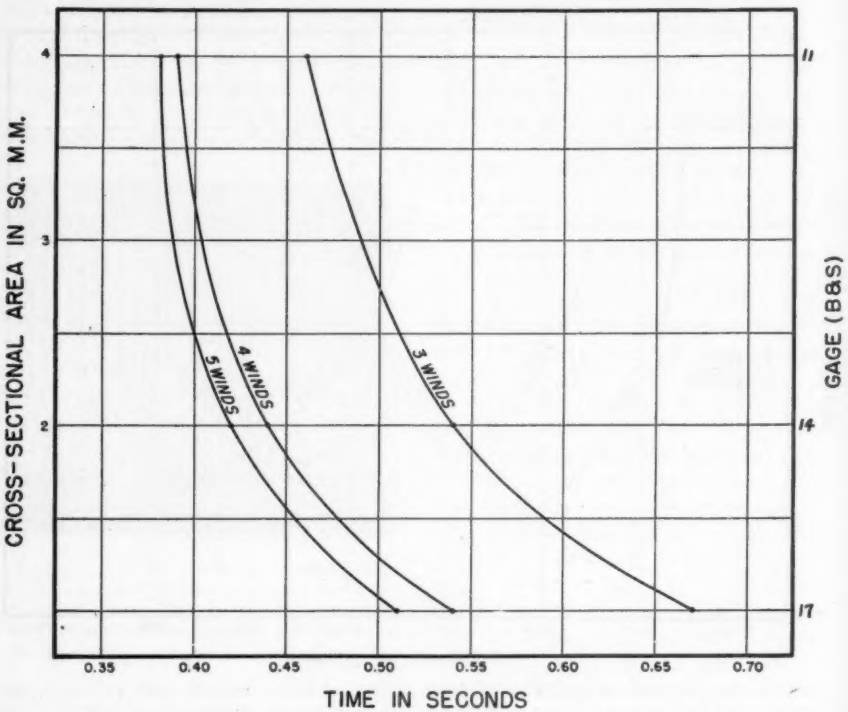


Fig. 7.—Graphic representation of effect of varying cross-sectional area of sprue on time required to cast gold by centrifugal force produced with varying winds of machine.

2. *Comparison of Time Required to Cast Gold Under Air Pressure and by Centrifugal Force.*—In comparing the values just discussed with those obtained in the experiments by Pfeiffer and me[1]

on air pressure casting, it was noticed that there was a tremendous increase in casting time with the centrifugal machine over that with the air pressure machine. It should be pointed out, however, that the time-interval measurements which these values represent were not made under identical conditions with the two machines.

In the experiments on air pressure casting, a measurement was made of the time interval between the application of pressure to the surface of the molten metal in the crucible and the instant that the pattern chamber was completely filled.

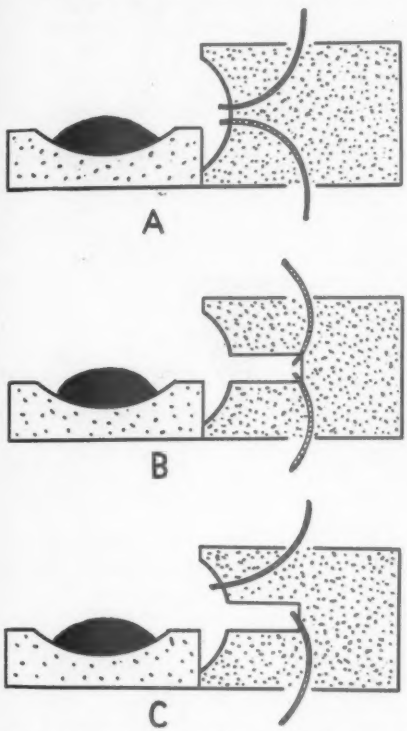


Fig. 8.—Diagrammatic representation of three types of molds, showing variations in position of contact wires. The molds were placed on the machine in such a manner that the wires extending through the holes in the flasks were in a horizontal plane rather than in a vertical plane as shown in the drawing.

In the experiments on centrifugal casting, a measurement was made of the time interval between the start of rotation of the cross-bar of the machine and the instant that the pattern chamber was completely filled.

It is true that the beginning of the interim in both cases represents the instant that force is applied to cast the metal, and in this respect it would seem that the conditions are identical. From a practical standpoint, cooling of the molten metal begins at the instant that the blowpipe flame is removed. By virtue of the mechanical design of the air pressure machine, the flame was removed from the metal before the valve which admitted the air was opened; while, in the centrifugal machine, the flame was removed simultaneously with the start of rotation of the cross-bar. This fact was recognized in the previous paper,[1] and measurements were made of the interim between the removal of the flame and the application of air pressure to the crucible. It was found that this time was far in excess of that required to cast the metal into the pattern chamber.

A comparison of the values for the time required to cast gold under air pressure and by centrifugal force is shown in Table 2. Three values are given in each square under air pressure. The first value represents the interim between the application of air pressure to the surface of the molten metal in the crucible and the complete filling of the pattern chamber. The second value represents the interim between the removal of the blowpipe flame and the application of air pressure to the metal. The third value is the sum of the first two and represents the interim between the removal of the blowpipe flame and the complete filling of the pattern chamber with metal.

For practical purposes, therefore, only

the third value should be considered in making comparisons of casting time between the air pressure and centrifugal machines used in these experiments. When this suggestion is followed, the results, given in Table 2, show a striking similarity between these machines under varying casting conditions.

It must be remembered that the values under discussion are determinations of casting time for cylindrical patterns measuring 6.4 mm. in diameter and 10 mm. in height. Since this volume represents 3½ pennyweights of metal, it may be regarded as well in excess of that required for the average dental casting. For this reason, a series of tests were made to determine casting time for cylindrical patterns measuring 6.4 mm. in diameter and 2.5 mm. in height, or a reduction in volume to one-fourth the previous size. The results, given in Table 3, show a marked reduction in casting time over that required for the larger patterns. These values, as well as those given in Table 2, emphasize the importance of using large sprues for this type of centrifugal machine, which precludes the premature entrance of molten metal into the mold.

3. *Behavior of Molten Metal During Centrifugal Casting.*—A series of experiments were carried out to measure the time required to move the molten metal from the fire-clay crucible in which it is first melted to the crucible of the casting flask. Investment molds were prepared without pattern chambers or sprues and provided with contact wires in the crucibles, as shown in Figure 8, A. The results, given in Table 4, show an average casting time of 0.12 seconds.

On first thought, it might appear that this information could be used to determine the pressure of the gold on the sprue for comparison with air pressure casting. Such calculations would be based on the assumption that the molten metal during centrifugal casting builds up over the sprue before any of the metal enters the sprue. To prove the fallacy of this assumption, a series of experiments were performed where variations were made in the position of the contact wires. The molds were prepared without using wax patterns, but allowing the removal of the sprue to form the only mold chamber. The design of these molds showing the position of the contact wires is illustrated in Figure 8, B and C. The results of six tests on each type are given in Table 5. The reduction in casting time on the molds having the contact wires at the end of the sprue can only

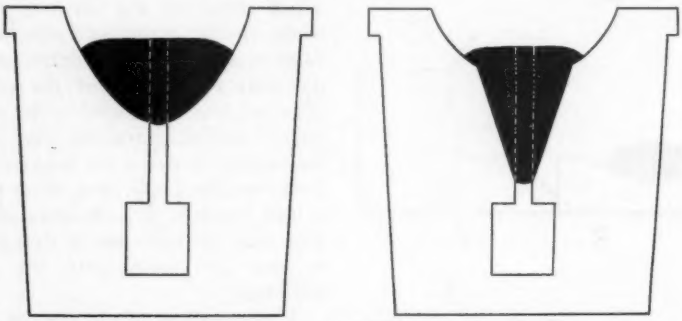


Fig. 9.—Cross-sectional details of two flasks showing increase in head of metal in tapered crucibles over that in conventional design. The magnitude of the black areas are identical, representing the same volume of metal in each crucible.

be a result of the movement of some of the metal through the sprue before it builds up in the crucible.

While the experiments just described involved the use of 11-gage sprues, other tests were made with smaller gages. The results were identical with those reported except when extremely small sprues were used. These data were discarded because the gages were too small to be included in the range of accepted casting practice.

4. *Effect of the Use of Tapered Crucible on the Time Required to Cast Gold.*—When a centrifugal machine is revolving at constant speed, the force varies directly with the weight of the casting metal. Most of this force, however, will be applied to the surface of

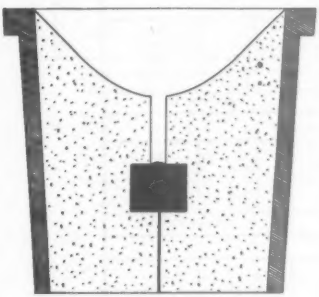


Fig. 10.—Cross-sectional details of mold showing hair channel extending from base of pattern to bottom of flask.

the crucible farthest from the axis of rotation and will not be effective in forcing the metal through the sprue. This will be true regardless of the shape of the crucible or the amount of metal that it contains.

On the other hand, the centrifugal force which causes movement of the molten metal into the sprue acts only on that portion of the metal directly over the sprue and is only a small fraction of the total force. For example, if 2 pennyweights, or 48 grains, of pure gold is melted over a 14-gage sprue in a conventional or spherical type crucible, the weight of the cylindrical column of metal directly over the sprue will be about 2.5 grains, or 5 per cent of the total mass. This value is the product of the cross-sectional area of the sprue, the height of the mass (measured) and the density of the metal.

It is obvious, then, that doubling the height of this column of metal over the sprue would double the force; but to bring about this condition in a spherical-type crucible would require many times the amount of metal indicated in the example. On the other hand, if the metal is cast into a distinctly tapered or cone-shaped crucible, the "head" of metal can be heightened without increasing the entire mass, as is shown in Figure 9.

Being aware of this principle as a means of increasing the force in centrifugal casting, it was thought advisable to measure the effect of the use of a tapered crucible on casting time. Accordingly, a special crucible former was prepared and used in a series of experiments. The castings were made through 11-gage, 14-gage and 17-gage sprues under centrifugal force produced with four winds of the machine. Two sizes of patterns were used, but the amount of casting metal was kept constant. The results of these tests are given in Table 6.

A comparison of these values with those previously obtained, using the conventional-type crucible, is shown in Table 7. It is apparent from a study of these data that the use of a tapered crucible results in a reduction in casting time, especially with the larger sprues and pattern chambers. This reduction is explained by the fact that the increase in the weight of the column of metal over the sprue in a tapered crucible over that in a conventional crucible is greater with the larger sprues.

The difference in the length of the sprues, shown in Figure 9, may be disregarded since it was previously determ-

ined by experiment[1] that this variable has no effect on casting time.

During the performance of these experiments, an observation was made which enhances the advantage of using tapered sprues in centrifugal casting. In the tests on the molds having a contact wire in the crucible, as shown in Figure 8, C, it was observed that, during the casting operation, the electrical contact between the molten metal and the wire would first be made, then broken and made again. It was later determined that this irregularity in the tracings was due to the fact that the mass of gold, after reaching the investment crucible, was thrown from the center toward the periphery in the direction of rotation of the machine. This sudden movement of the gold, which is in the opposite direction from the usual line of spill in centrifugal casting, was found to be caused by a swinging of the jointed arm of the cross-bar beyond center at the beginning of rotation. In other words, the pivoted flask carrier during operation of the machine swings from its starting position, which is at right angles to the cross-bar, to a parallel position and then beyond at a slight angle on the opposite side.

This explanation was verified by simply changing the position of the contact wire in the crucible and making trial castings with mercury. When the flask was turned so as to place the contact wire in the direction of rotation, no irregularity in the tracing occurred, since the rolling of the mass of metal allowed contact to be maintained with the wire. But if the flask was turned so as to place the contact wire on the opposite side of the crucible and away from the direction of rotation, the movement of the mass of gold would leave the wire and break the electrical contact. The pivoting of the flask carrier beyond center position is due to momentum created at the start of rotation and is followed by a slight oscillating movement, which dies down with increasing speed of the machine. Hence,

TABLE 1.—TIME REQUIRED TO CAST GOLD THROUGH 11-GAGE, 14-GAGE AND 17-GAGE (B & S) SPRUES BY CENTRIFUGAL FORCE PRODUCED WITH THREE, FOUR AND FIVE WINDS OF MACHINE

11-GAGE SPRUE		14-GAGE SPRUE		17-GAGE SPRUE	
Vibrations	Time (Seconds)	Vibrations	Time (Seconds)	Vibrations	Time (Seconds)
5 WINDS OF MACHINE					
23.5	0.373	25.0	0.397	32.5	0.516
24.5	0.389	26.5	0.421	33.0	0.524
24.5	0.389	27.0	0.428	32.0	0.508
23.5	0.373	27.0	0.428	32.0	0.508
23.0	0.365	26.0	0.413	31.0	0.493
Average 0.38		Average 0.42		Average 0.51	
4 WINDS OF MACHINE					
24.5	0.389	29.0	0.460	34.0	0.540
24.5	0.389	27.0	0.428	32.5	0.516
23.5	0.373	26.5	0.421	33.0	0.524
24.0	0.381	27.5	0.436	35.0	0.555
26.0	0.413	28.0	0.444	34.5	0.548
Average 0.39		Average 0.44		Average 0.54	
3 WINDS OF MACHINE					
29.0	0.460	35.0	0.555	43.0	0.683
27.0	0.428	34.0	0.540	43.0	0.683
30.0	0.476	34.0	0.540	41.0	0.651
29.5	0.468	34.0	0.540	41.5	0.659
28.5	0.452	33.0	0.524	42.5	0.675
Average 0.46		Average 0.54		Average 0.67	

Pattern, right cylinder (D. 6.4 mm. X H. 10 mm.)
Length of sprue, 8 mm.
Amount of gold, 5 dwt.

the mass of metal which was thrown toward the periphery of the crucible returns to its normal position directly over the sprue.

By varying the distance of the contact wire from the sprue, the magnitude of the movement of the molten metal was studied with differently shaped crucibles. It was found that this action of the metal was intensified with the use of more shallow crucibles and entirely eliminated with the substitution of tapered crucibles. In the latter case, the steep walls were sufficient to resist displacement of the metal during oscillation of the jointed arm.

5. *Pressure of Gold on Bottom of Pattern Chamber.*—The term pressure denotes the ratio between the force applied to any surface and the area of that surface. The unit of pressure is 1 pound per square inch and the graduation of pressure gages on casting machines is in this unit. In the case of air pressure casting, it is easy, therefore, to determine the degree of pressure which the molten metal exerts against the walls of the pattern chamber, since, in terms of Pascal's

TABLE 2.—COMPARISON OF TIME (IN SECONDS) REQUIRED TO CAST GOLD UNDER AIR PRESSURE AND BY CENTRIFUGAL FORCE

	AIR PRESSURE*			CENTRIFUGAL FORCE		
	20 LB./SQ.IN.	10 LB./SQ.IN.	5 LB./SQ.IN.	5 WINDS	4 WINDS	3 WINDS
11-GAGE SPRUE	0.03[1] + 0.34[2] = 0.37[3]	0.04[1] + 0.34[2] = 0.38[3]	0.06[1] + 0.34[2] = 0.40[3]	0.38	0.39	0.46
14-GAGE SPRUE	0.06[1] + 0.34[2] = 0.40[3]	0.07[1] + 0.34[2] = 0.41[3]	0.12[1] + 0.34[2] = 0.46[3]	0.42	0.44	0.54
17-GAGE SPRUE	0.11[1] + 0.34[2] = 0.45[3]	0.15[1] + 0.34[2] = 0.49[3]	0.25[1] + 0.34[2] = 0.59[3]	0.51	0.54	0.67

Pattern, right cylinder (D. 6.4 mm. X H. 10 mm.)
Length of sprue, 8 mm.
Amount of gold, 5 dwt.
Mold temperature, 650°C.
Temperature of casting gold kept as nearly constant as possible.
*All values under air pressure are taken from previous paper.
[1]Time required to fill pattern chamber with gold.
[2]Time required to close air pressure machine.
[3]Total time to close machine and fill pattern chamber.

TABLE 3.—TIME REQUIRED TO CAST GOLD THROUGH 8-GAGE, 11-GAGE, 14-GAGE AND 17-GAGE (B & S) SPRUES BY CENTRIFUGAL FORCE PRODUCED WITH FOUR WINDS OF MACHINE

8-GAGE SPRUE		11-GAGE SPRUE		14-GAGE SPRUE		17-GAGE SPRUE	
Vibrations	Time (Seconds)	Vibrations	Time (Seconds)	Vibrations	Time (Seconds)	Vibrations	Time (Seconds)
11.5	0.182	14.0	0.222	14.0	0.222	18.0	0.286
11.5	0.182	13.5	0.214	15.0	0.238	18.0	0.286
11.5	0.182	14.0	0.222	15.0	0.238	17.0	0.270
11.5	0.182	13.5	0.214	15.5	0.246	16.5	0.262
10.5	0.167	14.0	0.222	14.5	0.230	17.0	0.270
11.0	0.175	14.0	0.222	15.5	0.246	17.0	0.270
Average 0.18		Average 0.22		Average 0.24		Average 0.27	

Pattern, right cylinder (D. 6.4 mm. X H. 2.5 mm.)
Length of sprue, 8 mm.
Amount of gold, 5 dwt.

principle, "pressure is transmitted equally in all directions throughout a mass of fluid at rest."

In the case of centrifugal casting, extensive calculations must be made in order to determine the pressure of the molten metal against the walls of the pattern chamber. Here, we are dealing in forces which vary with the speed of the machine, the distance from the axis of rotation to the mass of metal and the weight of the casting metal. During the actual casting operation, all three of these factors are constantly changing. There is a gradual increase, first, in the speed of the machine, since it gains momentum after the take-off; second, in the distance from the axis of rotation to the mass of metal, since the metal moves toward the mold, and, third, in the weight of the metal, since the height of the column increases during the passage of the metal through the sprue.

Owing to these complications, it seems impossible to make any accurate calculations of pressure until after the molten metal has completely filled the pattern chamber, and the variables, with respect to the weight of metal and length of the arm, have become constant.

Accordingly, computations were made of the pressure of gold on the bottom of pattern chambers under varying conditions during centrifugal casting. The results are given in Table 8.

The values listed in columns 4 and 5 for the speed of the machine were determined by experiments which involved a measure of the time required for the machine to complete each revolution under different winds and a calculation of the speed of the machine in revolutions per second at any given time. A description of the method and results of these experiments will be published in the near future.

The values listed in column 6 for the weight of the metal filling the pattern chamber were determined by weighing the mass after solidification.

The values listed in column 7 for the weight of the sprue and excess were determined after the metal had solidified by measuring the distance from the pattern chamber to the top of the excess button and multiplying this value by the cross-sectional area of the sprue and the density of the metal.

An example of the method used in computing the values for the pressure of gold on the bottom of pattern chambers will follow a brief discussion of the

TABLE 4.—TIME REQUIRED FOR GOLD TO MOVE FROM FIRE-CLAY CRUCIBLE TO ENTRANCE OF SPRUE

Vibrations	Time (Seconds)
7.0	0.111
7.5	0.119
8.0	0.127
7.5	0.119
8.0	0.127
Average	0.12

Amount of gold, 5 dwt.
Winds of machine, 4.

TABLE 5.—RESULTS OF TESTS TO PROVE THAT MOLTEN METAL REACHES END OF SPRUE BEFORE IT BUILDS UP IN CRUCIBLE

BOTH CONTACT WIRES AT END OF SPRUE		ONE CONTACT WIRE AT END OF SPRUE AND OTHER ABOVE HOLE IN CRUCIBLE	
Vibrations	Time (Seconds)	Vibrations	Time (Seconds)
9.0	0.143	13.0	0.206
8.5	0.135	12.5	0.198
9.5	0.151	12.5	0.198
8.5	0.135	13.0	0.206
9.5	0.151	13.5	0.214
8.5	0.135	12.0	0.190
Average	0.14	Average	0.20

Length of sprue, 8 mm.
Gage of sprue, 11 (B&S)
Amount of gold, 5 dwt.
Winds of machine, 4.

formula for centrifugal force as applied to dental casting.

Centrifugal force acting on the gold in the pattern chamber may be expressed by the formula

$$F = \frac{4\pi^2 m n^2 r}{g}$$

While this equation is given in the form found in most physic texts expressing "m" in pounds and "r" in feet, it may be simplified to suit the units used in machines for dental casting. We are concerned with the weight of the metal in pennyweights and the radius of the circular path in inches. Since there are 12 inches in a foot and 292 troy pennyweights in an avoirdupois pound, we may write

$$F = \frac{4\pi^2 \left(\frac{m}{292}\right) \times \left(\frac{r}{12}\right) n^2}{32.2}$$

$$F = \frac{4 \times 3.1416^2 \, m \, r \, n^2}{32.2 \times 292 \times 12}$$

where F is still the force in pounds, m is now the mass in pennyweights, r is now the radius of the circular path in inches and n is again the number of revolutions per second. The constants of this equation may be combined to simplify the equation

$$F = \left(\frac{4 \times 3.1416^2}{32.2 \times 292 \times 12}\right) m \, r \, n^2$$

$$F = 0.00035 \, m \, r \, n^2$$

Using this formula and substituting the values of the first example in Table 8, we have

$$F = 0.00035 \times 3.95 \times 6.75 \times 8.8^2$$

$$F = 0.71 \text{ pounds of force.}$$

Since this force acts over an area of the bottom of the pattern chamber (0.05 square inch), the pressure defined as unit area is

$$P = \frac{\text{total force}}{\text{area}} = \frac{0.71}{0.05} = 14.2 \text{ pounds per square inch.}$$

This value is the actual pressure as a result of the centrifugal force at the instant the casting was completed. This means that the machine had reached a speed of 8.8 revolutions per second in 38/100 second, which was the time required to fill the pattern chamber.

If the metal continued to remain molten while the speed of the machine increased to its maximum, we would have

$$F = 0.00035 \times 3.95 \times 6.75 \times 11.5^2$$

$$F = 1.25 \text{ pounds of force.}$$

and

$$P = \frac{1.25}{0.05} = 25 \text{ pounds per square inch.}$$

The actual value for the foregoing is probably somewhere between 14.2 and 25 pounds per square inch, since the exact time of the solidification of the metal could not be determined.

It must be remembered that this example involves the use of a large pattern chamber. The low values in Table 8, for the small patterns, are due to a marked reduction in casting time, speed of the machine and weight of the metal.

In order to verify these theoretical calculations, by experiment, a method was devised to determine the pressure of the molten metal on the bottom of the pattern chamber by actual test with both types of machines. This was accomplished by preparing a mold with a small channel extending from the base of the pattern chamber to the bottom of the flask and measuring the force required to cast mercury through the opening. The values given in Table 9 represent pressures in pounds per square inch for the air pressure machine, and centrifugal force in winds of the spring for the centrifugal machine.

The cross-sectional details of one of these molds is shown in Figure 10. Before investing, a human hair was attached to the center of the base of the wax pattern and allowed to extend

through the bottom of the flask. Investment material was then poured into the flask. The wax pattern and hair were burned out by heating the mold to 230° C. and maintaining that temperature for several hours. The flask was allowed to cool to room temperature; and the investment was sealed to the walls of the flask with wax to prevent any escape of air due to contraction of the investment material. The flask was then placed on an air pressure machine with a cardboard receptacle under the flask. A quantity of mercury placed in the crucible was forced into the mold with air pressure. The excess mercury in the crucible was poured out, leaving only that portion in the sprue and pattern chamber. Low air pressure, controlled with a mercury manometer, was then applied to the mold and increased in successive amounts until the mercury in the mold was forced through the hair channel and allowed to collect in the cardboard receptacle.

The flask was emptied and refilled with enough mercury to occupy the pattern chamber and sprue. It was then placed on a centrifugal machine with the cardboard cap on the bottom of the flask. The centrifugal force was increased in successive amounts by increasing the winds of the machine until the mercury was again forced through the hair channel and appeared in the receptacle.

These experiments were repeated on another mold containing a pattern chamber of smaller volume. The results from the use of two of these molds are given in Table 9.

The difference in the pressure values for the two molds is not due to a variation in the size of the patterns, but rather to a variation in the size of the hair channels, which obviously could not be kept constant.

The values for equivalent pressure in pounds per square inch with the centrifugal machine were obtained by calculation.

In the case of mold 1 (Table 9), the following conditions were presented: weight of mercury filling pattern chamber, 2.8 pennyweights; distance from axis of rotation to bottom of pattern chamber, 6.75 inches; maximum speed of machine (two winds), 5.5 revolutions per second, and area of bottom of pattern chamber, 0.05 square inch. Hence $F = 0.00035 \times 2.8 \times 6.75 \times 30.25 = 0.2$ pounds. Since this force acts over an area of the

TABLE 6.—RESULTS OF USE OF TAPERED CRUCIBLE ON TIME REQUIRED TO CAST GOLD BY CENTRIFUGAL FORCE PRODUCED WITH FOUR WINDS OF MACHINE

11-GAGE SPRUE		14-GAGE SPRUE		17-GAGE SPRUE	
Vibrations	Time (Seconds)	Vibrations	Time (Seconds)	Vibrations	Time (Seconds)
PATTERN, RIGHT CYLINDER (DIAMETER 6.4 MM. X HEIGHT 10 MM.)					
17.5	0.278	21.0	0.333	28.0	0.444
17.0	0.270	23.0	0.365	29.5	0.468
19.5	0.309	20.5	0.325	31.5	0.500
18.0	0.286	20.0	0.317	28.0	0.444
19.0	0.301	22.0	0.349	29.0	0.460
Average 0.29		Average 0.34		Average 0.46	
PATTERN, RIGHT CYLINDER (DIAMETER 6.4 MM. X HEIGHT 2.5 MM.)					
13.0	0.206	13.5	0.214	15.0	0.238
13.0	0.206	14.0	0.222	16.0	0.254
12.0	0.190	14.0	0.222	15.5	0.246
11.5	0.182	13.5	0.214	15.0	0.238
12.0	0.190	14.0	0.222	16.0	0.254
Average 0.19		Average 0.22		Average 0.25	

Amount of gold, 5 dwt.

bottom of the pattern chamber, the pressure applied was

$$P = \frac{F}{A} = \frac{0.2}{0.05} = 4 \text{ pounds per square inch.}$$

This is the actual pressure arising from three and one-half winds or 8.8 revolutions per second. Hence, the centrifugal force was 0.255 pound and the actual pressure on the bottom of the pattern chamber was 5 pounds per square inch.

TABLE 7.—COMPARISON OF USE OF CONVENTIONAL AND TAPERED CRUCIBLES ON TIME REQUIRED TO CAST GOLD INTO PATTERN CHAMBERS THROUGH SPRUES OF VARYING GAGES

		11-Gage Sprue	14-Gage Sprue	17-Gage Sprue
PATTERN, RIGHT CYLINDER (D. 6.4 mm. x H. 10 mm.) (Volume 3.5 pennyweight)	Conventional Crucible	0.39	0.44	0.54
	Tapered Crucible	0.29	0.34	0.46
PATTERN, RIGHT CYLINDER (D. 6.4 mm. x H. 2.5 mm.) (Volume 0.88 pennyweight)	Conventional Crucible	0.22	0.24	0.27
	Tapered Crucible	0.19	0.22	0.25

Values are average time in seconds and are taken from Tables 1, 3 and 6.
All tests made with 4 winds of the machine.

TABLE 8.—PRESSURE OF GOLD ON BOTTOM OF PATTERN CHAMBER UNDER VARYING CONDITIONS DURING CENTRIFUGAL CASTING

Number of Winds of Machine	Gage Of Sprue (B&S)	Time to Complete Casting (Second)	Speed of Machine at Completion of Casting (R.P.S.)	Maximum Speed of Machine (R.P.S.)	Weight of Casting Gold (Pennyweight)			Radius of Circular Path (Inch)	Pressure on Bottom of Pattern Chamber (Pounds per Square Inch)	
					Pattern Chamber	Sprue and Excess	Total		At Completion of Casting	At Maximum Speed of Machine if Metal Remains Molten
PATTERN, RIGHT CYLINDER (DIAMETER 6.4 MM. X HEIGHT 10 MM.)										
5	11	0.38	8.8	11.5	3.5	0.45	3.95	6.75	14.2	25
4	11	0.39	7.7	9.7	3.5	0.45	3.95	6.75	10.6	18
3	11	0.46	7.1	7.9	3.5	0.45	3.95	6.75	9.0	12
5	14	0.42	9.5	11.5	3.5	0.26	3.76	6.75	16.2	24
4	14	0.44	8.5	9.7	3.5	0.26	3.76	6.75	13.0	17
3	14	0.54	7.5	7.9	3.5	0.26	3.76	6.75	10.2	11
5	17	0.51	10.5	11.5	3.5	0.13	3.63	6.75	18.8	22
4	17	0.54	9.5	9.7	3.5	0.13	3.63	6.75	15.4	16
3	17	0.67	7.9	7.9	3.5	0.13	3.63	6.75	10.6	10.6
PATTERN, RIGHT CYLINDER (DIAMETER 6.4 MM. X HEIGHT 2.5 MM.)										
4	11	0.22	3.8	9.7	0.87	0.51	1.38	6.50	0.87	5.6
4	14	0.24	4.3	9.7	0.87	0.32	1.19	6.50	1.00	5.1
4	17	0.27	5.0	9.7	0.87	0.16	1.03	6.50	1.17	4.3

Values for the speed of the machine were determined by experiment.
Length of sprue, 8 mm.
Amount of gold, 5 dwt.

the centrifugal force produced with two winds of the machine.

In the case of mold 2 (Table 9), the only changes were in the weight of the mercury, which was one-half that used in the first example, and the speed of the machine, which was increased to

While the data given in Table 9 are limited to the values obtained from two molds only, numerous tests were run on other molds, with similar results. In no case was there more than one-fourth pound difference between the pressure measured with the air machine

and the pressure calculated from the measured winds with the centrifugal machine.

It is probable that the slightly higher values obtained for both molds on the air pressure machine over those for the centrifugal machine were due to some leakage of air through the investment material, resulting in less pressure being applied to the metal itself.

CONCLUSIONS

1. Centrifugal casting time is regarded as the interim between the start of rotation of the cross-bar of the machine and the instant that the pattern chamber is completely filled with molten metal. In a previous paper[1] embracing a study of air pressure casting, measurements were made of the interim between the application of air pressure to the surfaces of the molten metal in the crucible and the instant that the pattern chamber was completely filled. A comparison of values for casting time with the air pressure and centrifugal machines shows a marked difference in favor of the pressure machine. From a practical standpoint, however, this comparison is hardly a valid one. Since cooling of the molten metal begins at the instant that the blowpipe flame is removed, casting time on the pressure machine should be regarded as the interim between the removal of the flame and the instant that the mold is filled. When the values obtained under the latter condition are compared with those of centrifugal casting time, there is a striking similarity of results with the two machines.

2. The time required to cast gold by centrifugal force through sprues of varying gages is appreciably increased when the force is reduced by decreasing the number of winds of the machine. Likewise, the casting time with forces produced by varying winds is appreciably increased when the size of the sprue is reduced. Moreover, the cross-sectional area of the sprue has a greater influence on casting time than does the number of winds of the machine.

3. Within limits, it may be stated that any increase in centrifugal force is accompanied by a decrease in casting time.

4. Centrifugal force is directly proportional to the square of the speed of the machine in revolutions per second. For example, doubling the speed of the machine increases the force four times.

5. The centrifugal force varies directly with the radius of the circular path. For example, doubling the length of the arm of the machine (distance from the axis of rotation to the mass of metal) doubles the force.

6. The centrifugal force is directly proportional to the weight of the mass

TABLE 9.—COMPARISON OF AIR PRESSURE AND CENTRIFUGAL FORCE REQUIRED TO CAST MERCURY THROUGH HAIR CHANNEL EXTENDING FROM BOTTOM OF PATTERN CHAMBER, AND CALCULATED PRESSURE OF MERCURY ON BOTTOM OF PATTERN CHAMBER

	AIR PRESSURE MACHINE	CENTRIFUGAL MACHINE	
	PRESSURE (LB./SQ. IN.)	WINDS	EQUIVALENT PRESSURE (LB./SQ. IN.)
Mold No. 1 Pattern, right cylinder (D. 6.4 mm. x H. 10 mm.) Gage of sprue, 14 (B&S); length, 8 mm. Area of bottom of pattern chamber, 0.05 sq. in. Weight of mercury, 2.8 pennyweight.	4½	2	4
Mold No. 2 Pattern, right cylinder (D. 6.4 mm. x H. 5 mm.) Gage of sprue, 14 (B&S); length, 8 mm. Area of bottom of pattern chamber, 0.05 sq. in. Weight of mercury, 1.4 pennyweight.	5½	3½	5

of metal. The force causing movement of the molten metal into the mold cavity, however, acts only on that portion of the metal directly over the sprue. The remainder of the mass exerts a force against the walls of the crucible and is not effective in moving the metal into the sprue. Doubling the "effective mass" of metal doubles the force.

7. Increasing the length and cross-sectional area of the sprue reduces the casting time because of the greater weight of the effective mass of metal. Hence, the advantage of using large sprues with centrifugal machines.

8. Casting time is reduced by the use of tapered crucibles because a given volume of molten metal in a tapered crucible will have a greater "head" than when the same volume is placed in a spherical type crucible. Moreover, a tapered crucible will prevent any movement of the mass of metal away from the sprue during oscillation of the pivoted flask carrier in machines having a jointed cross-bar.

9. More speed of the machine (number of winds) is required to cast small designs, since the weight of the effective mass of metal is reduced. Conversely, less speed is needed when the volume of the casting is greater.

10. Under customary conditions of centrifugal casting, small designs (weighing approximately 1 pennyweight) are cast within the first revolution of the machine. Moreover, the time required for the molten metal to move from the fire-clay crucible to the investment crucible of the flask is approximately one-half that required for the machine to complete the first revolution.

11. With the use of conventional sprues and crucibles, some of the molten metal reaches the pattern chamber before the mass of metal builds up in the investment crucible; hence, it seems impractical to attempt any calculation of the pressure of the molten metal over the sprue for comparison with air pressure casting. Furthermore, the force which is effective in causing the metal to enter and spread throughout the mold cavity varies with the speed of the machine; the distance from the axis of rotation to the mass of metal, and the weight of the column of metal directly over the sprue. Since all three of these factors are gradually increasing during the casting operation, it seems impossible to make any accurate calculations of pressure until after the molten metal has completely filled the pattern chamber, and the variables, with respect to the weight of metal and length of the arm, have become constant.

12. Theoretical calculations of pressure in pounds per square inch of the molten metal on the bottom of pattern chambers under varying conditions were made and verified by actual tests with both air pressure and centrifugal machines.

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DELAYED EXPANSION IN NON-ZINC ALLOYS

By James T. Sweeney, D.D.S., Stockton, Calif.

THE clinical amalgam research program instituted by the dental section of the Stockton State Hospital included a series of restorations made with a non-zinc amalgam alloy. The alloy was made especially for this work by a manufacturer in December 1938.

The objective was to ascertain whether an amalgam, packed from a non-zinc amalgam, would retain its shape, color and luster in comparison with the regular alloy made by the same manufacturer. Periodical examinations disclosed that the non-zinc amalgam compared favorably in every way, but apparently was less distorted over a two-year period.

The reports on delayed expansion of amalgams due to palming, by R. C. Angell and W. S. Crowell; K. H. Strader; E. W. Skinner and J. R. Jarabak, and Wilmer Souder, I. C. Schoonover and I. R. Beall at the National Bureau of Standards[1] led to the investigation of excessive expansion that may occur in non-zinc amalgams when mixed with solutions of sodium chloride.

As only one alloy was used during 1938-1939, it was decided to employ at least three in the present program. Two of the zinc-free alloys were furnished by K. W. Ray, Ph.D., General Refineries, Inc., and the other by Edward O. Leibig, B.S., Baker and Co., Inc.

Clean alloys of the regular types containing zinc were used as controls. All of the fillings were made by mulling the mix of amalgam before condensation, in the bare palm, with the addition of 1 drop of a 0.9 per cent solution of sodium chloride. The zinc and the non-zinc amalgams received identical treatment before packing.

The mechanical amalgamator, timed in seconds, was used for trituration of all specimens. Condensation was accomplished by hand, following the technic outlined in The Journal, September 1941.[2]

Most of the test fillings were condensed in Class V cavities in the mouths of a selected group of patients. A few were condensed in molds in the laboratory, measured with a Brown and Sharpe micrometer, and placed in the incubator at body temperature.

The regular alloys containing zinc, when amalgamated and packed into molds in the laboratory, expand over long periods of time even when the specimens are kept in air. K. W. Ray, who has been working for several months on the causes of this long continued expansion of amalgams, reported in a private communication to us that even greater expansions occurred when the specimens were kept in water or saliva. He also reported that saliva, water or salt solution incorporated in amalgams made from zinc alloys caused excessive growth and corrosion, but that this was not true with amalgam specimens made from non-zinc alloys. Our own laboratory tests confirmed this.

A few flow specimens were packed and tested from the non-zinc amalgams, with and without contamination with chlorides. In most instances, the flow was slightly reduced (0.1 to 0.4 per cent), when the amalgam was mulled with solutions of sodium chloride.

The difficulties encountered in the

clinical observation of amalgam are obvious. Only gross volume changes can be noted. In all of the restorations made in the clinic with the regular zinc alloys mixed with solutions of sodium chloride, surfaces became pitted within sixty days. Occasionally, one would manifest excessive expansion by a raised area on the surface of the filling. It was quite interesting to observe that where the expansion was sufficient to cause bulging in the center of the Class V filling, no pain was experienced by the patient, even though a cavity lining or other medication was not used.

In comparison, all of the non-zinc restorations give no clinical evidence of distortion. Occasionally, one of this series presents a very slightly pitted surface, especially where access to the cavity for condensation has been difficult.

It is hoped that this brief report will encourage further clinical research with non-zinc alloys.

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State Hospital.

THE AMERICAN DENTAL ASSOCIATION IN 1940-1941, A YEAR OF CRISIS

By WILFRED H. ROBINSON, D.D.S., Oakland, Calif.

DURING the past year, the unrest, so apparent in the last decade, has finally crystallized. Since the fabulous days of 1929 and 1930, through the years of the depression, almost no phase of national life has emerged untouched. At the present time, our country is facing an unlimited national emergency that may deepen into the reality of war or may dissolve, more happily, in a renewal of peace.

No matter what the ultimate outcome of these national problems, dentistry still will have many serious professional problems that must be met and solved in the coming years.

It is neither wise nor desirable to say that the decision to be taken by the nation in the coming months will not have an influence on the manner of solving the problems of the organized dental profession. Dentistry, as a health service profession, is an integral part of the social fabric of this country, and the pattern of that fabric will be altered in accordance with the decision for peace or for war.

In the last ten years, there have been many changes in the social structure of this country. The unprecedented economic depression; the need for governmental intervention in the providing of necessities of life that we know as relief; the growing assumption by the government of responsibility for various phases of human welfare; the need of production and manpower during the unlimited national emergency—all of these have been threads in this complex social design of the past decade. Many of these changes will continue for years to come to influence definitely the Amer-

President's Address, read at the Eighty-Third Annual Meeting of the American Dental Association, Houston, Texas, October 27, 1941.

ican way of living, and thus they must be considered in planning for the future. No profession can survive and live apart from its own times.

If the dental profession in this country is to assume its proper place in the social pattern as a health service vital to the well-being of millions of citizens, certain problems must be faced and solved by the profession. One of the most important of these great problems demands the organization of dentists into a unified body that can formulate and make effective a sound national policy in the interests of better national dental health. In meeting this problem, the profession has already made great progress. The American Dental Association, the national organ of the profession in this country, now has more than fifty thousand members. This number represents approximately 70 per cent of those who are eligible for membership; a representation second to that of no other similar professional organization.

During the past year, intensive efforts have been made, in connection with matters of dental preparedness, to ascertain the dental population of this country. This information not only will serve as a valuable stimulus to increase the membership, but also, if present plans are carried to a conclusion, will, through the medium of a dental directory, provide data valuable in many activities of professional life.

In the years of growing membership, the prestige and activities of the American Dental Association have continually attracted new members. This prestige must be enhanced and these activities must be continued so that the American Dental Association shall offer to every dentist in this country an opportunity for membership that cannot easily be declined.

The increasing importance and influence of the American Dental Association are no product of scattered and occasional effort. They are the direct result of many years of intensive planning and work that have been participated in by thousands of members in every state and territory within the United States. They are the direct result of a sound interest in the advancement of dental health for the people of this country; the direct result of the benefits that have been brought to the members themselves through the agency of the American Dental Association.

The American Dental Association supports many activities that have an undeniable influence on the progress of dentistry within our nation. Through its Council on Dental Education, it seeks high standards for future practitioners of dentistry. Through its Committee on Public Health and Education, and through its Bureau of Public Relations, it seeks to increase the appreciation of the public for the valuable health service that dentistry can render. Through its Dental Preparedness Committee, it makes available the resources of the profession in the interests of national defense. Through its Council on Dental Therapeutics, both the public and the profession are protected from exploitation by misinformed or unscrupulous manufacturers in the use of inferior or deleterious dental products. Through its Relief Fund, it provides a measure of security for those of its members who have fallen on unfortunate days. Through its National Health Program Committee, it seeks to establish sound policies under which better dental care may be provided for ever enlarging groups of the population.

The simpler routine tasks of these committees involve tremendous expenditures of time and money. Add to them the projects carried on by many other committees, and also add to them the special problems that have arisen in this period of extreme change, and you will understand more clearly the rôle that the American Dental Association plays in the advancement of dentistry in this

country, for the benefit of its population.

The expansion of all these activities by the American Dental Association in recent years is evidenced in the fact that it has outgrown the quarters which housed it for many years. The increasing personnel of the Central Office and the need for expansion in certain departments led to the acquisition of a new home. This five-story building is to be completely remodeled to meet the needs of the Association and should provide ample facilities for expansion in years to come.

All of the activities mentioned would have been progress and problems enough, for they represent the regular functions of a normal year in the life of the American Dental Association; but, during the past year, special problems were presented to the profession in placing the nation under an unlimited national emergency. The dental profession was called upon to lend its efforts to perfecting plans to meet the problems of defense and the existing crisis. As has been the custom in the past, the American Dental Association immediately extended its cooperation and aid to the government. This cooperation and aid has taken many forms and has helped to solve many grave problems. Because of the enormous interest and importance attached to all phases of the national emergency, it may be well to sketch briefly the various steps that have been taken by the American Dental Association in marshaling and conserving the resources of the dental profession to meet dentistry's great responsibility in the present national emergency.

More than a year ago, it became apparent that, as the emergency increased, it would be essential to have exact knowledge of the resources of the dental profession in this country. Accordingly, the American Dental Association undertook a census of all dentists in the United States. This was a tremendous task, involving, as it did, the preparation of huge mailing lists, the recording and indexing of questionnaires and the establishment of a follow-up system to insure a maximum of returns. This work, which is still in progress, has already furnished the Association and military authorities with invaluable information on dental personnel in this country. In the event that the emergency becomes more acute, this store of information will aid in securing a proper disposition of dental personnel for both military and civilian purposes.

In September 1940, the Selective Service law was enacted. This situation immediately presented new problems in dental preparedness. Dental examinations had to be provided for the millions of young men who registered under the act. No dentists were assigned to the local draft boards to make the dental examinations. These examinations were made, in the majority of cases, by the draft board physicians.

After the act had been in operation for some time, it was found that dentally deficient registrants were allowed to pass the local draft board dental examination, only to be rejected for service after examination by the induction board, when examination was made by a dentist.

It can easily be seen that such a system worked an unnecessary hardship on the registrant. After passing the dental examination of his draft board, the registrant made his preparations to leave civilian life. This entailed giving up his employment and other changes of an important personal character. When the registrant reached the induction board, dental defects that should have been discovered in the first examination necessitated his rejection for military service. This hardship on the registrant could have been avoided easily had dentists been assigned to the local draft boards to make the original dental examination a competent one.

The Dental Preparedness Committee

of the American Dental Association faced this problem and, in May 1941, the Selective Service System changed its regulations "to authorize the assignment of dentists as examiners to local selective service boards, to serve in the same capacity as medical examiners in their respective fields." Thus the American Dental Association had an important rôle in the discontinuance of this unsatisfactory procedure.

As the Selective Service Act did not provide for group deferment of any type of essential personnel, dental students as well as dentists were subject to the requirements of the act. This created new problems of a very serious nature since one of the great problems of a profession in a national emergency is the maintenance of an adequate personnel for both civilian and military needs.

It is common knowledge in the dental profession that we are not completely replacing the dentists who die or retire each year with new graduates. In other words, even the normal enrollment of the dental schools at the present time will not maintain the profession in its present numbers. To diminish this personnel still further by inducting dental students into the army before they had been graduated presented a problem of the most serious character. Under such procedure, there could be no assurance that enough dentists would be available in the near future to care for civilian and military needs at anything like the present level. When this fact is considered in the light of the very great number of dental defects that were found in the Selective Service examinations, it can be seen how imperative it was that immediate action be taken.

The Selective Service Act, however, applied not only to dental students, but also to dentists within the draft age. It was estimated that approximately 21,000 dentists (for ages 21 to 36) were within this age limit, and thus there was an even greater danger of further depletion of the supply of dentists for military and civilian purposes. Unless a dentist was granted a commission, he was unable to practice his profession while in the army, and if inducted as a private, he would be assigned to duties for which he was untrained, while his years of arduous study and preparation would be wasted and lost. This act made it impossible for him to give the service to his country that his training made possible.

The granting of commissions to those dentists liable to induction would have been a solution to this problem. Six weeks after the passage of the Selective Service Act, however, appointments in the Dental Reserve Corps were suspended except for those with low draft numbers. Three months later, even these appointments were suspended, and every drafted dentist was compelled to serve as a private.

This situation was intolerable, not only from the viewpoint of the profession, but also from the standpoint of military and civilian needs that had to be served. The American Dental Association, through its Dental Preparedness Committee, immediately requested of the Adjutant General of the United States Army that the quota of dental officers in the Reserve Corps be raised to prevent this loss of dental manpower by induction as privates. No action followed this request.

In February 1941, Senator Murray of Montana had introduced into the United States Senate a bill to correct this situation with regard to dentists, dental students, physicians and medical students. The Association strongly supported this bill at the hearing held by the Senate. The position the Association took, however, was not supported by the ranking dental official of the Army.

Four months after all appointments had been suspended in the Dental Reserve Corps, the Selective Service System finally issued to all state directors an order which eased the situation, but did not completely solve this important prob-

lem. Dentists who had been inducted as privates were to "be encouraged to apply for appointment (in the Dental Reserve Corps) so that they may serve in a professional capacity." The order also stated that it "is of paramount importance that the supply (of dental students) be not only maintained, but encouraged to grow, and that no student who gives promise of becoming a qualified dentist be called to military service before attaining that status."

These orders had the effect of relieving the situation. Dental students, in the main, are now being deferred until they have been graduated. Drafted dentists may apply for a commission and, if the commission is granted, are assigned to a new twelve-month period of service as dentists. This is obviously unfair in that it imposes a penalty of additional service upon the dentists who have been inducted as privates, through no fault of their own. This discrimination should be eliminated as speedily as possible. In addition, every effort should be made to shorten the time between application for a commission and the decision as to granting it. Because this situation was not foreseen or corrected more speedily and more effectively by the proper officials, one hundred and sixty-seven dentists have been inducted into the Army as privates, and of this number ninety are now serving in that capacity.

The American Dental Association has made a tremendous effort to have these difficulties eliminated as rapidly as possible so that dental preparedness will not be jeopardized. With the facilities and data now available in the Central Office of the American Dental Association, individual problems pertaining to dentists or dental students can be studied and solved with a minimum of effort and delay. The Association should continue to work for a satisfactory adjustment of dental reserve corps quotas so that defense efforts in the future will not be hampered.

The enactment of the Selective Service law brought with it still another problem. The examination of registrants revealed a very great number of dental defects, and a large percentage of rejections for military service were based on dental conditions. This was no surprise to dentistry. Through the Bureau of Public Relations of the American Dental Association, the public had been warned that probably a larger percentage of young men would be rejected solely because of dental defects than were rejected in the 1917 draft. Several months before the Selective Service System went into effect, figures were released on the basis of preliminary statistics gathered in a "dental health census" of the United States which was being made by the Committee on Economics. At the Annual Meeting in Cleveland in September 1940, more than a month before the first number was called under the Selective Service System, the chairman of the American Dental Association Committee on Economics and the chairman of the Committee on Dental Preparedness issued a joint statement, which was widely published, declaring that the "nation is wofully unprepared, dentally, to meet an emergency."

These predictions, based on the facts at hand, were borne out almost to the last decimal point, in the dental rejections of Selective Service applicants. Certainly, no one who is familiar with the facts in the case will concede any failure on the part of the profession. Moreover, except in the dental journals, where editors sought through sensible self-criticism to determine the causes, not a word of reproach was directed against dentistry in the wave of publicity attending the rejections for physical disabilities.

For many years, individual dentists and the organized profession have pointed out the distressing dental condition of the population. They have asked for aid in establishing and maintaining

dental health programs and have sought a better understanding and greater cooperation from dental health agencies. These appeals and requests remained, for the most part, unheeded and unanswered. Dental health programs, established under the initiative of dentists or dental societies, were allowed to lapse because those agencies with a responsibility toward dental health would not assume that responsibility. Dental health education programs were supported meagerly, if at all, by other than dentists, dental societies and a relatively few enlightened communities and private agencies.

The result of this evasion of responsibility to dental health on the part of the whole nation is now apparent under the Selective Service System. But it is not the point here to place the blame, but to designate the error of the past so that it may not be repeated in the future. Only if every agency with a responsibility for the dental health of the country assumes that responsibility can the nation and the citizens hope for anything less than the tremendous accumulation of dental disease which now impairs the military manpower of the nation.

Whatever the cause of the high percentage of dental defects in those of military age, the fact remains that the armed forces are being deprived of needed manpower. The only encouraging fact is that many dentally deficient registrants can be rehabilitated by dental care so that they can assume their military obligations.

In an effort to provide professional leadership in this important question, the Board of Trustees of the American Dental Association met in special session in August to consider this problem. Out of that meeting emerged a sound plan whereby the dentally rejected can be made available for military service. It now appears that one of the recommendations suggested by the American Dental Association will be the basis for an attempt at dental rehabilitation on a national scale. The details of this recommendation cannot, at this time, be divulged, but they will soon be announced to the profession and to the public. If this program is developed in accordance with the principles insisted upon by the American Dental Association for the protection of the public, the profession of dentistry will be confronted with an unprecedented opportunity to make a contribution of great value in time of national need. Dentistry faces this tremendous program of rehabilitation with the utmost confidence.

Thus the American Dental Association has cooperated actively with the government in solving problems arising out of the emergency. It is not unlikely that other problems will shortly be brought before us, and to these problems the American Dental Association will devote all of its resources and abilities. If the emergency becomes more acute, the country will find the profession ready to respond to any call.

It is important that we shall not lose sight of the background of these emergency problems. It is important also that we do not lose sight of conditions that may arise in the future as a result of the manner of solving these problems. The emergency must not be allowed to impair the profession's initiative in rendering service to the American people.

This is not an imaginary danger. We have just been through a decade of unprecedented social change. The nation's needs have been sharpened by chaos abroad and preparation for defense at home. This preparation has been somewhat retarded by the high percentage of dental defects in those of military age. The methods of the profession in working toward a higher level of national dental health are being evaluated very critically. It is because of this situation that attempts will be made to apply a new formula to traditional methods of

practice. If that formula includes the imposition of federal or state control on the profession, if it includes factors that will impair the dispensation of sound dental service to the public, that formula cannot be accepted by the American Dental Association. The emergency must not be used as a pretext by any individual or group to force compliance with, or acquiescence in, unsound practice, thereby jeopardizing the dental health of the American people.

Such a period as this, however, with its new responsibilities, its urgent demands, its increased consciousness of the importance of national dental health and its opportunity to serve, can be a rich and rewarding one for the individual dentist and for the American Dental Association.

Realities must be recognized; facts must be faced; opportunities must be seized, and leadership must be forthcoming. Only if these things are done can the nation and the profession look forward to a less pressing time, when the dental health of the people will be at a new high level.

The blue prints for this progress are at hand. Only the aroused interest of the public and the intensified efforts of the individual dentist and dental profession can make of them a reality. Dental disease must be attacked on a national scale, with every individual and every community and state assuming its proper responsibility to dental health.

Dental research must be intensified until the laboratories of the nation yield the secrets of the causes of dental disease. Only then can a highly effective mass attack be made upon the ravages which it causes.

Dental health education must be carried on universally, effectively. Every parent and every community must be made to realize that this is one of the most important roads to better dental health.

Dental service must be made available to all groups of the population. Preventive dental care must be emphasized to make impossible a tremendous accumulation of dental defects in the future. The coming generations must be kept free from the burden of neglected, accumulating and destructive dental disease.

This is not the task of the few, nor is it to be accomplished in the span of a few months or years. It is the continuing task of a generation. Failure to initiate it now will carry its accomplishment still farther into the future. Delay will reflect itself in the impaired health of the nation.

For many generations, the organized profession has zealously devoted itself to this task. The fruits of this effort are now seen in an increased national consciousness of the importance of dental health. With this aid, the organized profession can now march reinforced to combat dental disease. The results of that encounter will mean better health for the manpower of this country in time of crisis. And perhaps even more than that, it will bring in the time of peace a new source of strength and happiness to the American people.

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PROCUREMENT AND ASSIGNMENT AGENCY FOR PROFESSIONAL PERSONNEL IN THE ARMY

IN conformity with the policy of the Government toward the care of the health of the nation, the President's Health and Medical Committee, through its Subcommittee on Medical Education, has recommended to President Roosevelt the establishment of a Procurement and Assignment Agency which will have for its objective the procurement and assignment of physicians and dentists for service in the Army, the Navy, the Public Health Service, the Selective Service and for the Civilian and Industrial needs of the nation.

Both the Medical and the Dental Preparedness Committees have been looking forward to the time when such an agency would be necessary. For the dental profession, we have felt the need of such an agency from the day when the first dentist was drafted into line service in the Army. It was evident to all that such indiscriminate drafting of professional men who were particularly qualified and trained to render a service far more valuable than line service would seriously handicap the dental profession in its service to the public as well as to the Army. And from the moment of the induction of the first dentist

into line service, we have been casting about for ways and means of correcting a most undesirable condition.

The medical profession has been faced with the same problem in lesser degree, and while the question of shortage of professional man power is not of as serious moment to medicine as it is to dentistry, the danger of misuse of physical professional equipment has been very apparent. Looking forward with forebodings to the possible dangers of such a state of affairs, the American Medical Association, at its annual meeting in Cleveland, in 1941, passed a resolution recommending the establishment of an agency which would direct the procurement and assignment of medical and dental personnel in the various governmental activities incident to the present emergency.

Accordingly, the President's Health and Medical Committee called a conference of the interests involved on October 22, 1941, which, after consideration of the problems, both medical and dental, appointed a committee to make a further study and report at a later date to the Health and Medical Committee. This special committee made its report to the Health and Medical Committee October 28, 1941, and out of that second conference of all the interests involved came the resolution recommending the establishment of the office of procurement and assignment of physicians, dentists and veterinarians, to consist of a board of five chosen from members of the medical, dental or veterinary professions, and not to include any salaried governmental federal employes.

The following paragraph embodies the fundamental principles upon which the board is to be established and will determine the basic policy of its actions.

"The function of the board shall be to procure personnel from existing qualified members of the professions concerned. The board shall receive from various governmental and other agencies requests for medical, dental and veterinary personnel. These requests shall indicate the number of men desired, the time during which they must be secured, the qualifications of and limitations placed upon such personnel. The board may then by appropriate mechanism arrange to secure lists of professional personnel available, utilizing such existing rosters public and private as it may find acceptable, to meet these requirements. It shall also be authorized to approach such professional personnel as is considered to be available and to use suitable means to stimulate voluntary enrollment."

The resolution was presented to the Health and Medical Committee and through them to Mr. Paul V. McNutt, Federal Security Administrator. Mr. McNutt in turn presented the matter to the President, with suitable recommendations; and, with the President's approval, the following were appointed as the Procurement and Assignment Agency: Frank H. Lahey, M.D., Boston, Mass.; Harold S. Diehl, M.D., Minneapolis, Minn.; James E. Paullin, M.D., Atlanta, Ga.; Harvey B. Stone, M.D., Baltimore, Md., and C. Willard Camalier, D.D.S., Washington, D. C.

Mr. McNutt's recommendation provided for a full-time executive officer (with salary) and such assistants as would be required to carry out the functions of the agency.

The office was duly established and, November 6, 1941, the Agency held its first meeting, organized and began functioning.

All well and good, and the whole project appears set and ready to render a valuable service to the professions, the Army and the civilian public. There is, however, a paragraph in Mr. McNutt's letter of recommendation to the President which, if its provisions become operative, will, we believe, defeat the purpose and spirit of the entire project:

"In addition I would propose to instruct the Agency to draft legislation which may be necessary to submit to the Congress providing for the involuntary recruitment of medical, dental and veterinary personnel, in the event the exigencies of the national emergency appeared to to require it."

Aside from the potentialities for demoralization of the dental profession embodied in the paragraph just noted, the Agency, we believe, provides a means of selecting and distributing the man power of the profession in a manner that will much facilitate the general aims and purposes of dental health service to the nation, and with little likelihood of wastage.

The Committee on Dental Preparedness of the American Dental Association and the Association itself lauds the spirit which impelled the present action. In fact, both the committee and the Association have taken time by the forelock in preparing for intelligent assistance to the Procurement and Assignment Agency in its aims and purposes.

Nearly two years ago, the American Dental Association, following the lead of the American Medical Association, made provision for the gathering together of information necessary for the Procurement and

Assignment Agency to carry out in an intelligent manner the purposes for which the Agency has been appointed.

The Association, through the Committee on Dental Preparedness, and at considerable expense, formulated and sent out a questionnaire to every dentist whose address could be procured, seeking all the information desirable and necessary for emergency purposes pertaining to every individual in the dental profession. In October 1940, these questionnaires were sent to seventy-two thousand dentists presumedly in active practice. Up to the present time and after several repeated efforts, there are still 25 per cent of those known to be in practice who have not answered the questionnaire.

In order for the Committee on Dental Preparedness to advise, direct and cooperate with the Procurement and Assignment Agency, it is absolutely necessary for the committee to have the information asked for, and from every member of the profession. We urge every dentist who has not yet answered his questionnaire to do so at once for the sake of his interest in his profession, for his own personal benefit and for the benefit of the civilian public. That one is not within the draft age is no reason for failure in this respect. In selecting or procuring dental personnel, the committee cannot determine how many dentists may be called from any district for army service until they have estimated the number of dentists necessary to provide dental service for the civilian population in the district; and as long as conferences that led to the establishment of the Agency do not intimate or recognize that there is a shortage of dentists to meet the various needs, there is imminent danger of a shortage in dental man power from an injudicious selection and apportionment of dentists.

The extra demand from military sources, however, is not the only call upon the dental ranks: there is need for extra dentists for the prosecution of the rehabilitation program; there is need for extra dentists in cantonment areas; there is need for extra dentists in the concentrated industrial areas, and there is need for as much dental service as ever in the civilian population.

The dental profession must exert every effort and call upon every resource to meet these needs, and the most helpful part that the individual can play is to cooperate in gathering information necessary for the new effort.

It is difficult to believe that any dentist could wilfully neglect to play

this small part, but the returns from some districts would indicate that the dental population is exceedingly indifferent, if not wilfully neglectful. In other communities, where the officers of the societies have been active in this work, the results are good. Two outstanding instances will illustrate our point: In one of the large cities where the indifference seems to be greatest, 402 dentists have failed to answer the questionnaire; so, too, in one of the largest states, only about 50 per cent of the dentists have responded to the questionnaire.

We are deeply conscious of the general indifference and even disdain toward the ordinary questionnaire—but the present instance is different: it concerns the welfare of the individual dentist, the welfare of the profession, the welfare of the armed forces and the welfare of the public.

Answer your questionnaire *now!* If you have misplaced or lost it, ask the American Dental Association for another one, and send it in at once!

A.D.A. CHRISTMAS SEALS

EVERY year, at the approach of the Yuletide season, it becomes our pleasant duty to lend our efforts toward augmenting the Dental Relief Fund through the sale of Christmas Seals. The returns from the annual sale of Christmas Seals is the principal source of support of this worthy beneficence, and we appeal to the spirit of generosity of each member of the Association to respond to the call this year as freely as, or more freely than, in past years.

The Report of the Relief Fund Committee for the past year shows an increase in the number of those who were compelled to ask aid from the fund, and we are glad to report that every need was readily supplied. In fact, even though the demands are increasing, the fund is showing a healthy increase each year, thanks to the generous response by the members to the yearly call for contributions.

The Relief Fund activity by the A. D. A. is unique in benefits offered to members of a professional organization. No other professional organization has undertaken to aid its unfortunate members, and this is a project in which we take an unusual degree of pride. In troublous times such as these and, in fact, in what may be called normal times, any and

all of us are apt to fall upon misfortune, and the knowledge that our parent organization has taken the precaution to provide financial relief in unforeseen emergencies affords a sense of security that is indeed a satisfaction.

This past year, members of thirty-one state societies participated in the relief benefits from the fund. Two states, Michigan and North Carolina, participated in the relief for the first time.

In our travels over the country and in contacts with various society officers and members, we have heard the criticism that the procedure for application for relief is bound around with so much red tape and such intimate personal questions that many worthy persons have refused to apply for relief. We do not, however, see that any more than ordinary business procedure is followed and the precautions taken are only those necessary to safeguard such a fund.

For several years, especially since the fund has grown to be quite large, the Relief Commission has felt the need for more detailed information concerning the applicant. Accordingly, an application form seeking the detailed information desired by the Commission was formulated, submitted to the Trustees at the Cleveland Meeting and adopted for trial for one year. Just previous to the Houston Meeting, in an effort to determine the reaction of the various societies to the new form, a letter was addressed to each state society secretary asking his opinion of and comments on the new application form. The replies to this questionnaire were on the whole quite satisfactory, but because of some pertinent adverse comments, the commission voted to change the form in such a manner as to make it less embarrassing to the applicant so unfortunate as to need assistance and yet obtain information necessary to make equitable grants and to protect the fund.

As an indication of the sincerity and seriousness of their obligation to the membership of the Association, the Relief Commissioners believe it to be the duty of every member of the American Dental Association to see that no needy member is overlooked. The relief payments should not be considered charity, but a benefit due our unfortunate members by virtue of their membership in the American Dental Association and their contributions to dentistry.

The requirements and rules for participation in the fund are simple and specific and should be readily conformed to by all eligible applicants.

First, of course, it is necessary that the applicant be in real need and eligible in every respect for assistance.

He must be a member in good standing of the American Dental Association.

The secretary of the state society of which the applicant is a member must satisfy the Commission of the applicant's worthiness and eligibility for relief.

The primary purpose of the Relief Fund is for relief of members of the Association, but, in 1935, a slight deviation was made from this limitation of participation to include the widows of members, provided the application is made within ninety days after the member's death; thus extending to the widow, for ninety days, the same privilege of participation in the relief that the member had while living, provided the member was eligible at the time of his death.

The Commission reports that it is constantly in receipt of letters of appreciation from those who have benefited by the fund, and if the letters could be made public, there is not, we believe, a member of our Association who would not be proud of the fact that he had taken part in such a commendable work.

The Christmas Seals have already come to you. Send to the Relief Fund your contribution of one dollar or two dollars, or even more, to a cause that brings manyfold returns in the satisfaction of having done a good deed.

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President's Message*

Mr. Chairman and Members of the House of Delegates:

PLEASE let me express sincere appreciation for the opportunity to serve the Association as President during the coming year. For me, and for any man, to come to the Presidency of a great national professional association is an honor, and it is more than an honor: it is a call to service. Insensible, indeed, would any man be if he did not feel deeply both the honor and the call to service. I assure you that I do. To the Association and to the advancement of the profession of dentistry, I shall give the best that is in me.

I want to say that I recognize the many sources of pressure upon the American Dental Association which exist and will continue as a result of the National Defense Program and the social revolution through which we are passing. At no time since 1840 has American Dentistry been brought face to face with so many serious problems the solution of which is in the interest of both the public and the profession. Therefore, as I recognize the forces for change which exist today, it is not strange that I should hold a few concepts regarding what should be done to direct these changes, so that the Association, collectively and through its individual members, can make its greatest contribution.

Of primary concern at the moment is the relation of the American Dental Association and the profession to national defense. You are as familiar with existing relationships as I am. However, I should like to make the point that the highest possible degree of coordination should exist between the American Dental Association and the offices of the Surgeon General of the Army, of the Navy and of the Public Health Service and the Chief of the Medical Division of the Selective Service. The emergency that we face clearly demands effective collaboration, and while there may at times be cause for impatience, we must remember that we are in a democracy, and that the essence of that democracy must be an intelligent give and take.

The question of rehabilitation is an important one at this time. Here again is an outstanding opportunity for the American Dental Association and its components to collaborate with governmental agencies. At the moment, it is not known just what basic plan for

*President's acceptance speech before the House of Delegates at Houston.

rehabilitation will be followed, although one has been advocated by the Commission on Physical Rehabilitation of the Federal Security Administration. The Board of Trustees of the American Dental Association has adopted the recommendations of the National Health Program Committee, and these recommendations have been transmitted to the proper government authorities. While there is a slight difference of opinion as to the direction that plans for rehabilitation should take, the difference is not great, although the implications that these plans have in advancing the cause of socialized dentistry or medicine must be fully recognized.

It is not known just how long compulsory military service will continue in this country. This fact, plus the existing status of the Selective Service, appears to indicate that, in the future as throughout the last year, many problems will arise that have to do with the status of dentists and dental students. In assisting in the solution of these problems, the Association will continue to have a significant task to perform.

In addition to the problems created by national defense and selective Service, and the pressure from our already existing social revolution, are those that are bound to come with the advent of peace. Should we face demobilization of the armed forces and the cessation of war industries, accompanied by a general decline in the pressure for production, we shall be confronted by issues that follow all wars. Although we can make no predictions, we point to the possible unemployment, the intense internal migration and the distress that followed the First World War.

There is every reason to believe that the problem of adjustment to a peace time status will be tremendous in its implications for both the public and the professions. Consequently, the plea that while we prepare for war, we should also be preparing for peace is quite a logical one. I am convinced that while the American Dental Association is making contributions to the National Defense, it should, as an association, look forward in an attempt to anticipate the problems which peace is likely to bring and attempt effective solutions.

While preparing to make our contribution to the national defense and continuing our normal activities, preparation for peace demands that we know where we stand. It has been suggested that in order to know more regarding the number, age group distribution, income, location and other facts concerning dentists in the United States, as well as the position of these dentists, and the social and economic pressure which besets them, there should be, in the American Dental

Association, a committee on dental economics, with an adequate full-time personnel. In many respects, the suggestion appears to be well taken. In any event, it indicates recognition of the fact that the American Dental Association has no small task before it. Certainly as an association of dentists, for dentists and for the public good as well, the American Dental Association should be a dynamic organization, with its objectives established through clear and deep study of existing problems.

Finally, may I say that I have no apprehension regarding the willingness and the ability of American Dentistry to face the issues of the future. As far as my own position is concerned, I shall seek the whole-hearted cooperation of each member of the organization, and each component; and, on the basis of that cooperation, I will strive to do the best that I can to assist in guiding the Association through what may be a very trying year for all of us.

In the formulation of this speech of acceptance, I am not unmindful of the thirty-five bureaus and committees whose problems must receive profound consideration. Time does not permit me to express myself with regard to their problems. I will attempt to cooperate with these and to coordinate their efforts to the best interests of the Association and the public whom we serve.

Orren a. Oliver

THE HOUSTON MEETING

THE Eighty-Third Annual Meeting of the American Dental Association, at Houston (October 27 to 31), was one of the most pleasant and profitable dental conventions held in many years, according to most of the 8,256 who were registered from all parts of the nation.

The word from official Washington, brought to the House of Delegates by Lieut. Com. C. Raymond Wells, chief dental officer of the Selective Service System, climaxed the general "good will" theme of the meeting.

The letter and spirit of the message that he delivered made it clear that the course the American Dental Association has taken with regard to the rôle the dentist should play in the national defense effort has won the complete approval of the government.

The last word that had been spoken by the American Dental Association prior to the convention was the August (1941) recommendation of the Board of Trustees for a program of rehabilitation of draftees rejected for dental defects. This recommendation had been under discussion in Washington during the intervening weeks and Commander Wells brought the decisions reached at the Washington conferences to the American Dental Association officials at the Houston meeting.

Rejected candidates for Selective Service whose dental defects are found remediable will "return to the local boards (of Selective Service), which will authorize the treatment and refer them to dentists in their community," Commander Wells stated. "The cost of the treatment will be borne by the Federal Government. Thus, the civilian practitioners will rehabilitate the men in their communities."

Then followed high tribute to dentistry. Referring to the rehabilitation recommendations of the American Dental Association Board of Trustees (THE JOURNAL, September 1941, pp. 1518-1520), Commander Wells said: "The Association is to be congratulated upon this forward step. It has shown a sincere and patriotic interest in the dental health of the nation. It is interesting to note that this interest parallels that of the President of the United States."

Significantly, he added: "The influence of the American Dental Association and its components and the way in which it executes its responsibility may determine future policies of dental rehabilitation in these United States."

The following motion by Harold W. Oppice, chairman of the National Health Program Committee, was unanimously adopted by the House of Delegates:

"I move that this House of Delegates express its sincere appreciation to the Selective Service System through Commander Wells for the message he has given us; for the complimentary expressions it contains and for the System's forthright approval of the American Dental Association's plan of rehabilitation formulated August 3, 1941."

The House of Delegates, at its first session, heard words of greeting from President Roosevelt, addressed to Wilfred H. Robinson, the American Dental Association President. The message read: "Will you extend my sincere greetings to the members of the American Dental Association. It is my hope that during this, your Eighty-Third Annual Meeting, you will present recommendations for improving the health of our young people. The nation needs the as-

sistance of all dentists in our national defense effort."

Dr. Robinson replied by wire: "Your words of greeting to the Eighty-Third Annual Meeting of the American Dental Association were received with great pleasure and close attention. Please be assured that the resources of American Dentistry are pledged to the endeavors you mention: improving the health of our young people and assistance in our national defense effort."

J. Ben Robinson, dean of the Baltimore (Md.) College of Dental Surgery, was made President Elect of the American Dental Association Thursday at the final session of the House of Delegates.

Oren A. Oliver, of Nashville, Tenn., succeeded Wilfred H. Robinson, of Oakland, Calif., to the presidency. Dr. Oliver served as President Elect for the year 1940-1941.

Boston was selected as the convention city for 1942. Other officers were elected as follows:

First Vice President, Walter H. Scherer, Houston, Texas.

Second Vice President, Ernest G. Sloman, San Francisco, Calif.

Third Vice President, William B. Dunning, New York, N. Y.

Secretary, Harry B. Pinney, Chicago, Ill.

Treasurer, Roscoe H. Volland, Iowa City, Iowa.

The Secretary and the Treasurer have served continuously since 1927.

Trustees representing six of the thirteen districts were elected this year as follows:

Third District, E. G. Meisel, Pittsburgh, Pa.

Fourth District, Edward J. Jennings, Trenton, N. J.

Fifth District, Clyde E. Minges, Rocky Mount, N. C.

Eighth District, Howard C. Miller, Chicago, Ill.

Ninth District, Clarence J. Wright, Lansing, Mich.

Eleventh District, Russell A. Sand, Fargo, N. D.

Dr. Sand is now stationed at Fort Leonard Wood, Mo., with the rank of captain.

An urgent call to Washington prevented Dr. Morris Fishbein, editor of the *Journal of the American Medical Association* from making his scheduled address at the Tuesday morning general session.

In his address at the First General Session, Dr. Robinson declared that the resources of American dentistry were pledged to aid in the national defense program. At the same time, Dr. Robinson called for cooperation of the public and of government agencies in bringing about a "time when the dental health of the people will be at new high levels," adding, "Dental diseases must be attacked on a national scale with every individual and every community and state assuming its proper responsibility to dental health. Dental research must be intensified until the laboratories of the nation yield the secrets of the causes of dental diseases. Only then can a highly effective, mass attack be made upon the ravages which they bring with them. Dental health education must be carried on more universally, more effectively. Every parent and every community must be made to realize that this is one of the most important ways to better dental health. Dental service must be made available to all groups of the population. Preventive dental care must be emphasized to prevent the tremendous accumulation of dental defects in the future. The coming generations must be kept free from the burden of neglected, accumulating and destructive dental disease."

Dedicated to the "dental health of the children of America," a motion picture, "About Faces," was shown for the first time at the close of the First General Session.

Showing the gradual appreciation by

an average American family of the value of early dental care, the picture was produced by the United States Public Health Service. Its production, at a cost of $10,000, was financed by Mr. Cator Woolford, business man and philanthropist, of Sterling, Ga., who has devoted much time and money to promoting dental as well as general health. Duplicate prints can be obtained from the Bureau of Public Relations of the American Dental Association, Chicago, and it is expected that the film will have a wide showing throughout the nation and Latin America.

J. G. Williams, of Atlanta, Ga., director of the Division of Dental Health Education of the Georgia Department of Public Health, who had acted as Mr. Woolford's representative in having the film made, prefaced its showing with thanks to the donor, who was present.

A silver plaque was presented by C. A. Yarborough, president of the Georgia Dental Association, inscribed "To Cator Woolford, in grateful appreciation of his leadership and contributions in the advancement of dental health. Presented by the Georgia Dental Association."

Tuesday was observed as Pan American Day, the first observance of its kind by the American Dental Association. Dental organizations of eighteen republics of the western hemisphere participated.

On Wednesday, the Dental Preparedness Committee of the American Dental Association held a well-attended luncheon meeting. Speakers were Commander Wells; Brig. Gen. Leigh C. Fairbank, commanding officer of the U. S. Army Dental Corps; Capt. Hubert J. Lehman, USN, dental officer in charge of the dental clinic at the Corpus Christi (Texas) Naval Air Station, and Lieut. Col. Richard H. Eanes, assistant chief of the medical division, Selective Service System. C. Willard Camalier, chairman of the committee, presided.

The Third General Session brought to the convention two outstanding figures in British dentistry, A. E. Rowlett, of Leicester, official representative of the British Dental Association, and Sir Harold Gillies, noted facial surgeon. Dr. Rowlett, a past president of the British Dental Association, is treasurer and a former president of the International Dental Federation.

Dental problems of the postwar period —what they are likely to be and how to meet them—formed the theme of the address of Dr. Rowlett. "In Great Britain, committees have been formed, with the approval of and under the direction of some of the ministries, in order to prepare the groundwork for postwar reconstruction," said Dr. Rowlett. 'Our own Association, working under the ministry of health, is busied with that section of the public health scheme known as postwar dental reconstruction."

Commenting on the British "panel" system, in which he finds flaws, Dr. Rowlett said: "We are far from our ideal of a complete dental service for the nation, and we must admit that our panel system . . . is not a complete answer to the problem. At the same time, it would be absurd to deny that it has brought benefit to the general health of the population who previously had no dental treatment at all. It has, however, one grave defect, which is that it tends to encourage multiple extraction and the insertion of dentures, rather than conservation of the natural teeth. This is due to two main facts, lack of realization as to the health value and the esthetic desirability of a regular well-kept set of natural teeth, and also the economic condition. . . . Education of the public must above all reach and convert those engaged in the health service of the community, the dental profession, the medical profession, the scholastic and nursing profession and, of equal importance, the mothers of this and of the coming generation."

Weaving into his narrative some de-

scription of conditions under which Britons are living as the result of frequent aerial bombardments, Sir Harold Gillies told of the work that is being done to repair human damage. "I carry cordial remembrances of many of your dental and surgical friends in England, particularly those who have specialized in fractures of the jaw," he said. He contrasted the present methods of war with those of the previous World War, stating that, in organizing the medical men for emergency service, a larger group of dentists was allowed for than was later found necessary.

"The number of jaw fracture cases that are brought to the hospitals is very much smaller than from such trench battles as occurred on the Somme in 1918," observed Sir Harold. "We have, of course, a large number of transport and military training accidents causing jaw fractures, and there are a small number of cases of airmen and others hit in the face by missiles. Very large percentages of our cases are purely plastic, such as are caused by burns, and without jaw involvement."

In taking over the presidency of the Association from Dr. Robinson, Dr. Oliver addressed the House of Delegates as follows:

"I recognize the many pressures upon the American Dental Association which have arisen and will continue to arise as a result of the National Defense Program, and from the social revolution through which we are passing. At no time since 1840 has American Dentistry been brought face to face with so many serious problems, the solution of which is in the interest of both the public and the profession.

"Of primary concern at the moment is the relation of the American Dental Association and the profession to National Defense. You are as familiar with existing relationships as I am. However, I should like to make the point that the highest possible degree of coordination must exist between the American Dental Association and the offices of the Surgeon General of the Army, the Navy, the Public Health Service and the Selective Service. The emergency which we face clearly demands effective collaboration, and while there may at times be cause for impatience, we must remember that we are in a democracy, and that the essence of that democracy must be an intelligent give and take.

"In addition to the problems created by National Defense and Selective Service, and the pressures from our already existing social revolution, are those which are bound to come with the advent of peace. Should we face demobilization of the armed forces and the cessation of war industries, accompanied by a general decline in the pressure for production, we will be confronted by issues which follow all wars. Although we can make no predictions, we can only point to possible unemployment, the intense internal migration and the distress which followed the First World War. There is every reason to believe that the problem of adjustment to a peace-time status will be tremendous in its implications for both the public and the professions. Consequently, the plea that while we prepare for war, we should also be preparing for peace is quite a logical one. I am convinced that while the American Dental Association is making contributions to National Defense, it should, as an Association, look forward in an attempt to anticipate the problems which peace is likely to bring and endeavor to prepare effective solutions.

"Finally, may I say that I have no apprehension regarding the willingness and the ability of American dentistry to face the issues of the future. As far as my own position is concerned, I shall seek the whole-hearted cooperation of each member of the organization, and each component, and on the basis of that cooperation, I shall strive to do the best that I can to assist in guiding the

Association through what may be a very trying year for all of us."

Judging from the many complimentary remarks overheard at the Coliseum, this year's Scientific and Health Exhibits were exceptional. Although fewer than at some previous meetings, their quality was higher. The hospitality, cooperation and help furnished by the local exhibit committee was thoroughly appreciated by the exhibitors.

The scientific and health exhibits committee announced awards for outstanding displays in the Hall of Exhibits at the Coliseum as follows:

Scientific Division, Institutions and Organizations: First, The Mayo Clinic, Rochester, Minn.; second, The Chicago College of Dental Surgery, Chicago, Ill.; third, University of Southern California, College of Dentistry, Los Angeles, Calif.

Individual: First, J. C. Bryant, Oak Terrace, Minn.; Second, P. J. Murphey, Dallas, Texas; third, George R. Warner, Denver, Colo.

Health and Education Division, Institutions and Organizations: First, Kellogg Foundation, Battle Creek, Mich.; second, Wisconsin State Dental Society, Madison, Wis.; third, American Dental Assistants Association.

Individual: First, Howard A. Hartman, Cleveland, Ohio.

Twenty-two outstanding motion pictures were shown in the Visual Education Program all day Monday, Tuesday morning, Thursday afternoon and all day Friday.

The Public Relations Committee performed an excellent piece of work. Nine radio broadcasts, eleven school lectures and three luncheon club lectures were given during the meeting. More than twenty dental window displays were placed in the windows of prominent stores. Drug and grocery stores and restaurants displayed charts and posters. The dairy companies distributed attractive leaflets inviting householders to visit the Scientific and Health Exhibits. For the first time in the Association's history, a teachers' institute was held. More than 1,800 Houston educators attended the program, which was devoted exclusively to children's dentistry.

The Committee on Publicity likewise did an outstanding piece of work. "Never before," said the Houston editors, "have we covered a convention that was so well handled from a publicity standpoint. Frankly, we were worried because of the highly technical nature of your papers, which we had neither the time nor the ability to decipher. It was a load off our mind to find that our work had been done for us." Naturally, this situation resulted in 100 per cent cooperation on the part of the Houston papers as evidenced by the space allocated to the Association's affairs.

At 3 p.m., Thursday, the entire nation heard about "A New Century of Dental Progress" in a round-table discussion broadcast over the blue network of the National Broadcasting Company. Those who participated were Wilfred H. Robinson, Oren A. Oliver and A. E. Rowlett.

From every angle and from every point of view, the Local Arrangements Committee did fine work. They left no stone unturned or deed undone to demonstrate southern hospitality and Texas efficiency. Even the Houston weather man turned down the heat and tempered it with cool breezes for the benefit of the northern visitors. Under the genial direction of the general chairman, Walter H. Scherer, the General Arrangements Committee established standards for future committees to shoot at. (Boston, please note.)

BUREAU OF PUBLIC RELATIONS

REPORT OF THE ANNUAL MEETING OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

CONVENTION HALL, Atlantic City, N. J., was the scene of the seventieth annual meeting of the American Public Health Association and meetings of related organizations, October 12-17, 1941.

The two-and-a-half-day institute on public health education preceding the regular meeting is worthy of mention as one of the highlights. Arrangements were made for 200 registrants for the institute and the facilities were overtaxed by more than twice that number, making the groups rather large for problem-solving discussions. Dentistry played an important rôle in this institute, especially in "Participation of Professional Groups in Health Education," with Lon W. Morrey upholding dentistry, and the panel discussion "Health Education Procedures for Local Dental Health Programs," with J. M. Wisan as the leader. Dr. Wisan utilized the leaders of one of his community groups, represented by two dentists, a nurse, a priest and several lay people, to portray a local dental health program. Walter J. Pelton summarized and Lieut.-Col. W. C. Webb, Jr., acted as secretary-reporter for this panel discussion.

Richard C. Leonard took part in a symposium on current problems in school health administration under sponsorship of the American School Health Association, presenting a paper entitled "Let's Have a Dental Program."

On Wednesday, the Oral Health Group and American School Health Association, at a joint luncheon session in the Hotel Chelsea presided over by J. M. Wisan, heard Prof. Ira V. Hiscock, of Yale, discuss the question "How Important Is the Dental Health Program, Nationally? Locally?"; also C. E. Turner reporting the work of his committee on "A Usable Dental Health Index for Schools." Lon W. Morrey discussed and summarized both papers.

There were approximately 100 persons attending the luncheon, of which but a few were dentists.

Leon R. Kramer presented a paper on "How to Organize and Conduct a Program of Public Health Dentistry Which Will Actually Reach Children of Preschool Age" in a clinic on administrative technics in local health programs before the health officers' section, Friday morning.

On Friday morning, a joint session was held by the Oral Health Group, the Food and Nutrition Section and the Maternal and Child Health Section. Several excellent papers of particular interest to dentists were presented, including a "Review of Present-Day Knowledge of Nutrition in Relation to Pregnancy and Lactation," by J. E. Becker, H. J. Bickerstaff, M.D., and N. J. Eastman, M.D., and "Effect of Nutrition During Pregnancy on Dental Health of Young Children," by Frances Krasnow, Ph.D.

In the Laboratory Section, Henry Welch and C. M. Brewer presented a report on "The Relative Toxicity of Certain Antiseptics Containing Soap and Alcohol with Special Reference to Mouth Washes."

Dentistry was represented in the scientific exhibits by the Bureau of Public Relations of the American Dental Association, the New Jersey State Department of Health and the Delaware State Board of Health.

The officers of the Oral Health Group for the past year were: Chairman, J.

M. Wisan, New Jersey State Department of Health; secretary, Allen O. Gruebbel, Missouri State Board of Health. The new officers are: chairman, Allen O. Gruebbel, and secretary, C. R. Taylor, Michigan Department of Health. St. Louis, Mo., was selected for the 1942 meeting.

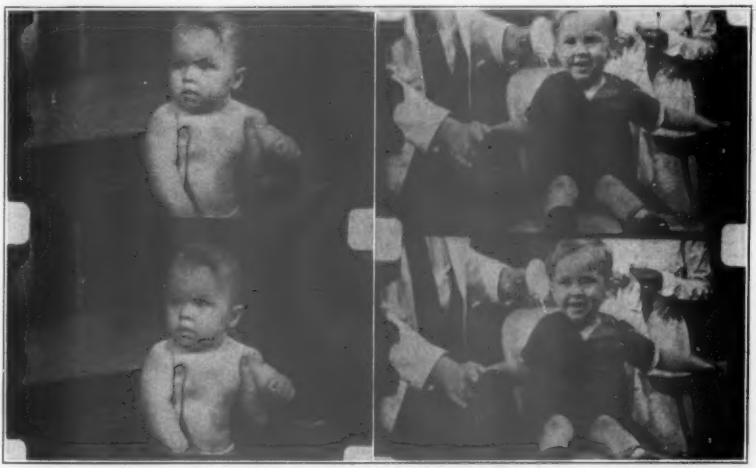
It is sincerely hoped that more dentists will become affiliated with the American Public Health Association. Secretaries of state dental societies and directors of state and municipal dental units might well become members and eventually fellows of the association. This is one way by which the dental viewpoint can be projected into the public health group.

ABOUT FACES

NEW DENTAL HEALTH EDUCATIONAL MOVIE

THE Eighty-Third Annual American Dental Association meeting furnished the setting for the premier showing of a new and much needed dental educational film. "About Faces" is cleverly named because it is—about faces. It is an 800 foot, 16 mm. sound kodachrome film. Dedicated to "the dental health of the children of America," it portrays the gradual appreciation, by an average American family, of the necessity of preventive dentistry and early dental care. It relates the dental experience of a boy from infancy, through the preschool and school period to early adulthood.

"About Faces" particularly stresses the value of early and regular dental care, while the desirability of proper nutrition and careful mouth hygiene are also shown.



(1) Before Tooth Trouble Began (2) Preventing Tooth Trouble

Presented by the United States Public Health Service in cooperation with the American Film Center, it was produced by Sound Masters, Inc., New York. It was financed by Mr. Cator Woolford, business man and philanthropist of Ster-

ling, Ga. J. G. Williams of Atlanta, Ga., director of the Division of Dental Health Education of the Georgia Department of Public Health, lifelong friend of the health of America's children and to Dr. Williams for his personal interest and efforts.

"About Faces" rents for the same price as other sound color films from the American Dental Association, Bureau of Public Relations: $2 a day or $6 a week. The purchase price is $85.

(3) Oh! Oh!

(4) Not so good!

(5) About Faces

(6) Not our hero!

donor, acted as Mr. Woolford's representative.

Dentistry is deeply indebted to Mr. Woolford for his fine contribution to the

COUNCIL ON DENTAL EDUCATION

SECOND CONGRESS ON DENTAL EDUCATION AND LICENSURE

THE Council on Dental Education of the American Dental Association will meet at the Palmer House, Chicago, Ill., Saturday, February 21, 1942. Minor J. Terry, chairman, will preside. Following is the program:

Morning Session 10 a.m.

(Ball Room)

Greetings

Oren A. Oliver, President of the American Dental Association.

A. L. Walsh, president of the American Association of Dental Schools.

Walter F. Barry, president of the National Association of Dental Examiners.

General topic for the morning session

How Can the Teaching in the Dental Schools and the Examining by State Boards of Dental Examiners Be Modernized and More Closely Articulated?

Teacher Approach

Charles F. Bodecker, professor of dentistry (oral histology), School of Dental and Oral Surgery, Columbia University.

Examiner Approach

Philip L. Schwartz, former member of the New Jersey State Board of Dental Examiners

Discussion

Luncheon Session 1 p.m.

(Ball Room)

How Can the Knowledge and the Skill of the Professions Be Employed to Meet the Needs of All the People?

(Speaker to be announced)

Afternoon Session 2:30 p.m.

(Ball Room)

General topic for afternoon session: Design of the Dental Curriculum

By Integration with Medicine

(Speaker to be announced)

By Autonomy in Administration and Teaching

Willard C. Fleming, dean of the College of Dentistry, University of California

Discussion

Members of the committee in charge are William M. Hodgkin, Chairman, Warrenton, Va.; J. Ben Robinson, Baltimore, Md.; Willard C. Fleming, San Francisco, Calif.; Walter A. Wilson, Trenton, N. J., and Harlan H. Horner, Chicago, Ill.

The price of the luncheon will be $1.50. Reservations can be made by addressing the Council on Dental Education, 212 East Superior St., Chicago, Ill.

RESEARCH COMMISSION

LIST OF CERTIFIED DENTURE RESINS

American Dental Association Specification No. 12

SAMPLES of the resins that were certified to the Research Commission by the various manufacturers as complying with the American Dental Association Specification No. 12 for Denture Base Material, Acrylic Resin or Mixtures of Acrylic and Other Resins were procured on the retail market by the Research Commission and were tested by the American Dental Association Research Associates at the National Bureau of Standards. The following certified resins were found to comply with the specification. Certified resins which did not comply with the specification are omitted from the list.

Material	Form	Certified by
B - B	Powder-liquid, clear	Bell Dental Products Company
B - B	Powder-liquid, pink	Bell Dental Products Company
Densene	Powder-liquid, clear	Cosmos Dental Products, Inc.
Densene	Powder-liquid, pink	Cosmos Dental Products, Inc.
Lucitone	Powder-liquid, clear	The L. D. Caulk Company
Lucitone	Powder-liquid, pink	The L. D. Caulk Company
Lucitone	Plastic cake, clear	The L. D. Caulk Company
Lucitone	Plastic cake, pink	The L. D. Caulk Company
Luxene 44	Plastic cake, pink	Luxene, Inc.
Strykers	Powder-liquid, pink	Strykers' Dental Products, Inc.
Vernonite	Powder-liquid, pink	Vernon-Benshoff Company
Vernonite	Plastic cake, clear	Vernon-Benshoff Company
Vernonite	Plastic cake, pink	Vernon-Benshoff Company
Vita-Lite	Powder-liquid, pink	Vita-Lite Products Company

NAVY DENTAL CORPS

THE following Navy dental officers were appointed, November 10, 1941, captains or commanders in the Regular Navy or commanders in the Naval Reserve:

DENTAL OFFICERS APPOINTED CAPTAINS

Comdr. David Lewis Cohen, (DC), USN

Comdr. Henry Raymond Delaney, (DC), USN

Comdr. Robert "H" Fladeland, (DC), USN

Comdr. Edward Brook Howell, (DC), USN

Comdr. Harry Lawrence Kalen, (DC), USN

Comdr. Charles Crawford Tinsley, (DC), USN

Comdr. Francis Graeme Ulen, (DC), USN

DENTAL OFFICERS APPOINTED COMMANDERS

Lt. Comdr. Henry Clay Lowry, (DC), USN

Lt. Comdr. Daniel Webster Ryan, (DC), USN

RESERVE DENTAL OFFICERS APPOINTED COMMANDERS DC-V(S), USNR.

Lt. Comdr. Charles Raymond Wells, DC-V(S), USNR

Lt. Comdr. Joseph L. B. Murray, DC-V(S), USNR

A. KNOX, *Captain* (DC), USN
Washington, D. C.

COUNCIL ON DENTAL THERAPEUTICS

THE BACTERICIDAL ACTION OF AN ALCOHOLIC SOLUTION OF FORMALDEHYDE AND SODIUM BORATE

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[This report contains the results of some investigations on a simple nonproprietary disinfecting solution suggested for inclusion in A.D.R. by the senior author several years ago. The Council has voted to submit this report for publication since it contains information of interest to dental practitioners. The findings may be considered in connection with other Council reports (J.A.D.A., 27:276, February 1940; 26: 2047, December 1939) and in connection with information in A.D.R. bearing on the broad topic "disinfection of dental instruments."—HAROLD L. HANSEN, *Secretary.*]

AN indispensable part of dental office equipment is a dependable instrument sterilizer. Most often, this device is one for boiling instruments in water for a period of time determined by experiment to be adequate for destroying the bacteria likely to be found. Appleton[1] sums up the disadvantages of this method of sterilization in his statement that "the objections to moist heat are rusting and dulling of cutting edges." He also mentions the fact that both these disadvantages can be overcome by adding an alkali to the water and keeping it below the boiling point during the process. Since dulling of cutting edges remains as an objectionable factor in boiling water sterilization, there exists a need for an inexpensive, yet reliably efficient preparation that can be used for sterilizing dental instruments.

An alcoholic solution of formaldehyde and sodium borate, suggested by one of us (J.L.B.) as a preparation of value in the "cold sterilization" of dental instruments was first mentioned in Accepted Dental Remedies 1935,[2] and has been described in subsequent editions of the book. The solution, apart from its disinfectant properties, does not rust and dull cutting edges and is both inexpensive and easy to handle. The present study is concerned with a modification of this solution from the aspect of its bactericidal efficiency.

The formula for this modified alcoholic solution of formaldehyde and sodium borate is as follows:

Solution of formaldehyde	50 cc.
Rubbing alcohol (70% ethyl alcohol)	450 cc.
Sodium borate	A sufficient quantity to make a saturated solution.

The solution of formaldehyde is the 40 per cent U.S.P. preparation. The rubbing alcohol is one marketed by any reliable firm. Rubbing alcohol is no doubt as good as unmedicated alcohol and has the advantage of being about one-fifth as costly. The sodium borate is incorporated to prevent rusting of instruments in the solution and is added in an excessive amount (usually 15 gm. in the foregoing formula). The

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undissolved portion is removed by straining.

In proposing a study of the bactericidal efficiency of this formaldehyde-alcohol solution, we are aware that we are not presenting a new subject for investigation. The value of formaldehyde solutions as disinfectants or germicides, particularly for inanimate objects, such as surgical instruments, has long been known. J. Leon Williams, in a letter addressed to the editor of *Dental Cosmos* more than thirty years ago, while disclaiming credit for its discovery, recommended the use of a saturated solution of borax in 20 per cent formaldehyde for the disinfection of instruments. In this article, we shall make no attempt to review the literature on the uses of solutions of formaldehyde as antiseptics, germicides or virucides.

The aim of this investigation is actually twofold. The primary purpose has been to determine the bactericidal efficiency of the formaldehyde-alcohol solution against the various types of bacteria that constitute a part of the oral flora of many individuals and to report the methods used in arriving at these evaluations. While performing the tests, the idea has constantly been the potential usefulness of the solution as a preparation for sterilizing certain types of dental instruments, particularly those that are marred by boiling water sterilization. However, the investigation was not designed to determine whether the solution is capable of effecting sterilization. The scope of such a problem is far broader than the one undertaken by us. Laboratory studies on germicidal action are always and of necessity limited in their application, for such studies cannot duplicate the exact conditions met in practice, however earnest the attempt to simulate these conditions. Some evaluations, of course, have greater merit than others, for some laboratory technics approximate more closely actual conditions than do others. We have concerned ourselves primarily with technics formulated according to the latter concept.

As the work progressed, it became apparent that the bactericidal evaluation of the solution could not be adequately presented without consideration of the general subject of the inadequacies of laboratory technics for testing germicides, particularly in relation to instrument sterilization, and of the fallacies inherent in interpreting the results of such technics. The investigation has been extended accordingly to include this subject.

The bacteria used to test the bactericidal activity of this solution of formaldehyde and alcohol were selected from species that occur with great frequency in the oral cavities of many individuals and are of dental and medical significance. The organisms selected were aerobes, non-spore-forming and non-acid-fast: *Staphylococcus aureus,* strain 209, of the Federal Food and Drug Administration; a beta hemolytic streptococcus isolated from the lips of a patient suffering from perlèche; a diphtheroid bacillus obtained from a patient suffering from rheumatic fever; and a strain of *Klebsiella pneumoniae,* type A. Pooled saliva and some organisms found to be of too low resistance were also employed in a few of the tests. All of the organisms used in this experimental study had been in artificial cultivation for varying periods of time, none less than a period of six months. The organisms employed in the tests were always used as pure cultures. Only one strain of each species was used.

We are aware that there are many aerobic, non-spore-forming, non-acid-fast bacteria inhabiting the mouth besides those that have been selected. In this work, we hope, however, that we have included bacteria of such frequent incidence and of such marked and varied resistance that the results obtained may be representative for members of this group.

We are also cognizant of the fact that various micro-organisms outside the above-mentioned grouping and also of dental importance have been omitted in this investigation, the inclusion of which would further the germicidal evaluation of the solution. We refer particularly to such bacterial forms as the acid-fast tubercle bacilli, the actinomyces, the fusiform bacilli and also spirochetes, protozoa and fungi. All of these forms are apt to contaminate dental instruments when constituting part of the flora of oral cavities. Besides these organisms, there are the sporulating aerobic and anaerobic bacteria, but these are of lesser significance, because contamination of instruments with either the spores or the vegetative cells of these bacteria is probably almost entirely from sources extrinsic to patients. The difficulty of propagating some of these micro-organisms in artificial culture media, the frequent necessity of animal inoculation to pick up small numbers of viable organisms in others, the wide divergence in resistance among the various morphologic forms of any particular fungus and the uncontrolled factors in spore survival often make accurate germicidal evaluation with many of these forms impractical and impossible. For these and other reasons, the germicidal effectiveness of this solution of formaldehyde and alcohol has not been evaluated on the basis of these organisms.

The culture media used throughout the tests were prepared according to the standardized formulae reported by Reddish[3] in his article on disinfectants and antiseptics in "Newer Knowledge of Bacteriology and Immunology," by Jordan and Falk, and by the Federal Food and Drug Administration[4] for the calculation of phenol coefficients. The base media were either extract-agar or extract broth. No attempt was made to ascertain the influence of culture media or of body fluids on alterations in the resistance of the organisms. Except for the purpose of wetting instruments, animal body fluids were used in only one series of tests. In these tests, pooled saliva and sterile horse serum were used to dilute the formaldehyde solution.

The determination of the solution as a bactericide has been confined to three types of tests: two tests in which instruments were employed and one test in which instruments were not used. These methods allow an estimate of the bactericidal activity of the solution and enable a comparison of technic and results.

TESTS WITH INSTRUMENTS

The laboratory methods with instruments were designed to simulate the practical conditions encountered during the process of sterilizing dental instruments. One of the methods, we believe, is as close an approach to practical conditions as is possible in laboratory tests. This method is reported in detail and is referred to as our standard method. The second method is only briefly reviewed. Some of the general aspects of these tests are similar to those reported by the Pease Laboratories[5] for the determination of the germicidal action of Bard-Parker germicide on spores of *Bacillus anthracis*.

The solution, examined by the standard method, was tested against four of the test organisms: *Staphylococcus aureus, Klebsiella pneumoniae,* the hemolytic streptococcus and the diphtheroid bacillus. The dental instruments employed for these tests were chosen for diversity of type and on the basis of their common use in dentistry. Four kinds of instruments were selected: smooth broaches, Kerr files, scalers and dental mirrors.

The procedure for the "standard" method follows in detail:

TECHNIC

Sterilize the instruments by boiling in water and wet them by immersion in sterile serum. Inoculate them heavily with a 24-

hour culture of the test organism grown on standard meat extract-agar. Inoculate the entire surfaces of the mirrors and smooth broaches, but inoculate only those parts of the scalers and Kerr files actually used on the teeth. Hold the instruments in dry sterile containers for thirty minutes. Remove them with sterile forceps, scrub in sterile water and rinse in two changes of sterile water. (The volume of water used for each washing is approximately 700 cc. Not more than six instruments are washed in one container.) Immerse each instrument totally in the washing water, and use a different pair of sterile forceps for each rinsing. Place the instruments in covered sterile containers, and allow the excess water to flow off. Put each instrument in a separate glass tube containing the test solution and hold for a definite period of time at room temperature (20°C.). Immerse the instruments totally in the test solution. (The size of the container and the volume of the test solution vary with the type of instrument, but they remain constant for each type.) Keep the test solution when not in use in paraffin-sealed, cork-stoppered tubes. (The solution is used many times, but not so often as to show perceptible dilution.) Do not use more than once in the same day. Remove the instruments from the solution at the expiration of the given time interval and dip them in a tube of sterile water to remove or dilute the solution remaining on them. Use a different pair of sterile forceps to remove each instrument from the medication tube. Place the instruments in tubes of standard broth (15 to 20 cc.) and leave overnight at 37°C. (This culture is designated as the subculture.) Remove each instrument from the subculture with sterile forceps the following morning and reincubate the subcultures for the remaining portion of a forty-eight hour interval. Transfer 1 cc. of the subculture prior to its incubation to 10 cc. of the standard broth medium. (This

TABLE 1.—BACTERICIDAL ACTIVITY OF A SOLUTION OF FORMALDEHYDE AND ALCOHOL USING A TECHNIC SPECIALLY DEVISED FOR INSTRUMENTS

Test Organisms Exclusive of Staphylococcus Aureus

	Exposure in Minutes to Test Solution																
	1	2	3	4	5	8	10	15	20	25	30	35	40	45	50	55
Organisms	Smooth broaches															
Hemolytic streptococcus	6−															
Klebsiella pneumoniae	4− 2+		6−													
Diphtheroid bacillus	6−															
	Kerr files															
Hemolytic streptococcus				6−												
Klebsiella pneumoniae	4− 2+		6−													
Diphtheroid bacillus			2− 4+			6−										
	Scalers									Dental mirrors						
Hemolytic streptococcus			5− 1+	6−				4− 2+	6−							
Klebsiella pneumoniae		5− 1+	6−							3− 3+		4− 2+			5− 1+	6−
Diphtheroid bacillus			2− 4+		5− 1+	6−			5− 1+	4− 2+	6−					

+, growth of bacteria in culture medium; −, no growth of bacteria in culture medium. Arabic numerals preceding + and − signs refer to number of tubes of culture medium in which treated instruments are placed. Six instruments were used in each test.

TABLE 2.—BACTERICIDAL ACTIVITY OF A SOLUTION OF FORMALDEHYDE AND ALCOHOL, USING A TECHNIC SPECIALLY DEVISED FOR INSTRUMENTS

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Test Organism: Staphylococcus Aureus, Strain 209

	Exposure in Minutes to Test Solution																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170
Smooth broaches	3− 3+		5− 1+	6−	6−																							
					6−																							
Kerr files					3− 3+					5− 1+	5− 1+	6−	6−															
												6−																
Scalers			4− 2+	4− 2+	4− 2+			4− 2+	6−	6−	6−																	
									6−																			
Dental mirrors														2− 4+	4− 2+	2− 4+	2− 4+	4− 2+		5− 1+		4− 2+			5− 1+	6−	6−	6−
																										6−		

+, growth of bacteria in culture medium; −, no growth of bacteria in culture medium. Arabic numerals preceding + and − signs refer to number of tubes of culture medium in which treated instruments are placed. Six instruments were used in each test.

culture, known as the resubculture, is incubated at 37°C. for forty-eight hours. Remove the subculture and the resubculture from the incubator at the end of forty-eight hours, and record the results of the test. Stain by Gram's technic those tubes that show growth, as evidenced by turbidity, and transfer to agar. Run controls by planting inoculated and washed, but non-medicated, instruments in the standard broth medium.

Before observing the results of the tests which were recorded in Tables 1 and 2, the reasons for the various procedures that constitute this standard method will be briefly discussed. The use of sterile instruments and pure cultures of bacteria made it possible to start the test with known components. This we deemed an essential procedure.

One of the chief aims in the standard method was to inoculate each instrument with as much bacterial growth as it could possibly accommodate. The use of instruments moistened with blood serum and use of agar cultures rather than broth cultures seemed excellent ways of assuring this result. Blood serum was selected as the moistening medium broth because it is a body fluid often present on dental instruments and because it has some adhesive properties. The use of agar cultures of bacteria and instruments prohibited a standardized inoculating dose of bacteria. In order to compensate for the differences that would occur with such a technic, a minimum of six instruments were arbitrarily selected as the number to be tested. The washing of inoculated instruments imitated the procedure followed in dental practice when instruments are brushed and washed in soap and running water to remove blood, pus, and tissue residue prior to sterilization.

The introduction of fallacious results was carefully avoided. The procedure of immersing medicated instruments in water after their removal from the test solution tended to reduce the number of false negative values. This process diluted the solution that remained on the instruments and that might be sufficient to inhibit the growth of organisms which were viable at the termination of the specified period of exposure to the preparation. The incubation of the instruments in the broth culture overnight also tended to reduce the number of negative results. Growth and reproduction did not depend on the transfer of viable organisms from instruments to broth tubes before the instruments were removed from the tubes, but proceeded among both those bacteria immediately dislodged from the instruments and those that remained attached to the instruments. Resubcultures were also included in the protocols to avoid false negative results that might occur through excessive concentrations of the test solution in the subculture. No resubculture exhibited growth when none occurred in the subculture. The practice of handling each instrument after medication with separate sterile forceps was followed in order to decrease false positive results. The process eliminated the possibility of transferring viable organisms from one instrument or culture tube to another. The preparation of smears from the positive broth cultures and the transfer of materials from these cultures to agar plates were further measures for checking results and technic. Tests in which broth cultures showed extraneous organisms, on the basis of either smear or culture, were discarded.

The determination of the bactericidal activity of the formaldehyde-alcohol solution was made on the basis of a set of arbitrary requirements. Before the solution was considered as exerting a bactericidal action that might be taken as a reliable index of its potency, it was necessary, first, that the results with all six instruments inoculated with the test organism and exposed for any given time interval be negative. Secondly, it was necessary that these results be confirmed by additional tests on another series of six instruments subjected to the same

procedure, for the same period of time and for a slightly longer period. These results have been designated by us as presumptive and confirmatory tests. When these conditions were met, the first time interval was taken as the shortest time in which the solution would act as a bactericide in relation to the particular organism and instrument tested. If the second series of six instruments failed to give negative results, the tests were continued for a progressively longer period of time until two consecutive intervals yielded negative results. Attainment of these two criteria was required only for *Staphylococcus aureus*. The greater resistance shown by this strain made confirmatory tests on the other three organisms seem unnecessary. Although the results of the tests with these organisms are included in this report, they lack the significance of those with *Staphylococcus aureus*. The presumptive and confirmatory tests with the staphylococcus strain are of greatest value in interpreting results and formulating conclusions concerning the bactericidal efficiency of this alcoholic solution of formaldehyde.

The results of these tests, as stated previously, are found in the tables. Table 1 records the results of the tests with smooth broaches, Kerr files, scalers and mirrors, using all of the test organisms except *Staphylococcus aureus*, strain 209. The tests with this organism are presented in Table 2.

In summarizing the results, three major facts are clearly discernible. First is the marked variation in results which occurs when instruments of the same type are inoculated with the same test organism and are exposed to the solution for the same length of time.

Second, the solution exhibits an effective bactericidal action against strains of hemolytic streptococci, diphtheroid bacteria, *Klebsiella pneumoniae* and staphylococci. This activity is more pronounced against the first three organisms than against the strain of *Staphylococcus aureus*. Moreover, only slight differences in potency are discernible with the first three bacteria.

Third, the effectiveness of the solution as a bactericide is observed to be dependent both on the strain of organism against which it is tested and on the type of instrument used in the test. The differences in the bactericidal action of the solution when mirrors, Kerr files, scalers and smooth broaches are contaminated is remarkable. The bactericidal power of the solution is seen at its highest when smooth broaches, Kerr files and scalers were inoculated with the hemolytic streptococcus strain, the diphtheroid bacillus and *Klebsiella pneumoniae*. Its potency was less when the mirrors were contaminated with these organisms than when the staphylococcus strain was used to contaminate instruments other than mirrors. The lowest degree of bactericidal efficiency was noted when the mirrors were inoculated with *Staphylococcus aureus*. Under the conditions of the test, the time exposures sufficient for the solution to function as a bactericide against all of the test organisms except *Staphylococcus aureus* were one to three minutes with smooth broaches, three to eight minutes with scalers and Kerr files and twenty to fifty-five minutes with mirrors. Against *Staphylococcus aureus*, the time was increased to four minutes with smooth broaches, nine minutes with scalers, twelve minutes with Kerr files and two and one-half hours with mirrors.

Two other methods of testing the bactericidal action of this solution will be briefly reviewed, in order to compare various methods of testing bactericides and to see how closely the bactericidal evaluations obtained with these methods resemble those of the standard method.

The second method used to determine the bactericidal efficiency of the solution is a modification of the "standard" method. The solution, under this method, was tested with the four types of

instruments and all of the test organisms, including pooled saliva. Both washed and unwashed instruments were tested. The unwashed instruments were transferred directly to the test solution after their inoculation with the test organisms. Instead of six instruments composing a series, as in the standard method, only two instruments were used. After medication and rinsing, both washed and unwashed instruments were removed from the broth subculture tubes within thirty minutes after their placement in this medium instead of the usual overnight contact, as in the standard procedure. The inoculated instruments were exposed to the solution for one, two, three, four and five minutes. All subcultures and resubcultures of the tests with washed instruments, even those with mirrors inoculated with *Staphylococcus aureus,* exhibited no growth after three minutes' exposure to the solution. With unwashed instruments, there was no growth after an exposure of four minutes.

TESTS WITHOUT INSTRUMENTS

The final method used to test the bactericidal activity of the alcoholic solution of formaldehyde did not make use of instruments. It is a modification of the Reddish germicidal test[6] for the determination of phenol coefficients. In selecting this method, no attempt was made to imitate practical conditions under which the solution would be used. A detailed description of the method is not attempted since the Reddish method can be found with ease in many texts which deal with the subject of disinfection. Deviations from the standard technic concerned the length of time the culture inoculum is left in contact with the solution, the bacteria used as test organisms and the serial dilutions of the test solution. In the Reddish germicidal test, the time intervals for medication of 0.5 cc. of 24-hour broth culture of the test organism in 5 cc. of the test solution are five, ten and fifteen minutes. In the modified form, used by us, the time exposures were fifteen and thirty seconds and one, two, three, four and five minutes. The tests were run at room temperature (20° C.), since the solution is used only outside the body. Controls on the viability of the organisms used in the tests were always included in the protocols.

The bacteria used in these tests included all seven of the strains previously listed as test organisms. In addition, pooled saliva was used. During the time that these investigations were in progress, broth cultures of *Staphylococcus aureus* always exhibited a resistance to phenol equivalent to that required for this organism by the Federal Food and Drug Administration[4] for the determination of phenol coefficients, which is that "at 20° C., it must survive a 1-60 dilution of phenol for five minutes and a 1-70 dilution of phenol for five minutes and a 1-80 dilution for fifteen minutes." The hemolytic streptococcus survived a 1-80 dilution for five minutes and a 1-100 dilution for fifteen minutes, and *Klebsiella pneumoniae,* a 1-80 dilution for five minutes and a 1-110 for fifteen minutes.

When the alcoholic solution of formaldehyde was examined by this method, growth never occurred in the broth subcultures which were seeded with a 4 mm. loopful of the medication mixture and incubated at 37° C. for forty-eight hours. When the solution was diluted with either 70 per cent alcohol or sterile horse serum, or sterile pooled saliva in the proportion of four parts of test solution to one part of diluent, the results were the same. The samples of pooled saliva which were tested exhibited the same lack of growth in the broth subcultures. Under the conditions of this test, the solution of formaldehyde and alcohol was found to be capable of exerting bactericidal activity within an exposure of fifteen seconds.

COMMENT

A comparison of the results of the three methods reported in this article shows that the modified phenol coefficient test and the second test reported with instruments definitely overestimate the bactericidal efficiency of the alcoholic solution of formaldehyde, especially as regards its potential value as a preparation for sterilizing instruments. The values assigned to this solution on the basis of those two tests, namely, fifteen seconds and four minutes, are totally misleading when compared with the results obtained with the method that has been designated as the standard. These results offer fresh evidence of the need for adequate and controlled technics if misconceptions regarding bactericidal values are to be eliminated.

The standard method affords a much fairer means of assaying bactericidal potency. Whether this should be the ultimate method of choice for determining the bactericidal or germicidal action of chemicals employed in the sterilization of instruments is not the question. We are of the opinion that, in the examination of a product that may be used in the sterilization of dental instruments, conditions no less rigid than those of our standard method should be required. Our interpretations of and conclusions regarding the specific bactericidal effectiveness of this alcoholic solution of formaldehyde are formulated solely on the basis of results obtained with this method.

The formaldehyde solution, as judged on the results obtained with the standard method, can definitely be considered a potent bactericide against the strains of organisms tested. Its potency, as that of any bactericidal preparation, varies with the different species of bacteria. Although it can be described with certainty only as a bactericidal agent against the micro-organisms tested, we are probably safe in assuming that it will function against the aerobic and non-sporulating bacteria to be found commonly in the mouth, with the possible exception of the acid-fast bacteria, on which we have accumulated no data.

The results of the laboratory tests also definitely emphasize the fact that the efficiency with which this solution functions as a bactericide cannot be determined without due consideration of the type of instrument to be sterilized. An exposure that is ample for one type of instrument will not necessarily be adequate for another type. This is no doubt true of the bactericidal efficiency of any chemical solution designed as a germicide for surgical instruments.

It is apparent that sterilization of certain kinds of instruments, such as smooth broaches, scalers and Kerr files, can be adequately carried out by chemical means, but such sterilization should not be attempted with dental mirrors or other instruments similarly constructed. If chemical sterilization of such instruments should be attempted in dental practice, the question of sterility would always be debatable. Moreover, the time required to effect sterilization, which in our laboratory procedure with the solution of formaldehyde and alcohol was, against *Staphylococcus aureus,* found to be two and one-half hours, would be so lengthy as to render such a method almost impracticable.

SUMMARY

An alcoholic solution of formaldehyde and sodium borate designed for the sterilization of dental instruments was examined to ascertain its bactericidal power against some of the bacteria of the oral cavity.

The laboratory method which was used to determine the bactericidal potency of this solution was so devised that it would simulate the practical conditions under which the solution would be used.

Tests of two other methods demonstrate that laboratory methods of testing

germicides which do not incorporate the foregoing principle in their procedures may be grossly misleading in that the bactericidal values that they assign to solutions are far in excess of actual values.

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ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following articles in the list of Accepted Dental Remedies.

DENTIFRICES*

Sam's Tooth Powder: Composition: See Sheffield Tooth Powder (J.A.D.A., 28:1883, November 1941).

Manufactured by the Sheffield Company, New London, Conn. Distributed by Sam's Cut Rate, Inc., Detroit, Mich.

Norlena Tooth Paste: Composition: See Milkident Dental Cream (A.D.R. Ed. 7, p. 110).

Manufactured by The Trade Laboratories, Inc., Newark, N. J. Distributed by Norlena Products, New York, N. Y.

Stevens-Wiley Tooth Powder: Composition: Each hundred grams is stated to contain precipitated calcium carbonate (Non-Fer-Al Brand), 81.40 gm.; sodium bicarbonate, 3.91 gm.; soap, 6.78 gm.; magnesium carbonate, 3.91 gm.; methyl salicylate, 3.91 gm.; saccharin, 0.09 gm.

ABRASIVENESS: 0.0108 mg. loss on antimony prism under weight of 63 gm. in 6,400 revolutions. (D. W. Horn apparatus. Details filed with Council.)

Manufactured by The Stevens-Wiley Manufacturing Co., Inc., Philadelphia, Pa.

*A.D.R. Ed. 7, p. 102.

COMMITTEE ON DENTAL PREPAREDNESS

A PROCUREMENT AND ASSIGNMENT AGENCY

FOR some time the Preparedness Committee has had before it the question of procuring and assigning qualified dental practitioners to the governmental services. Although the action of the Selective Service System in inducting dentists into the Army as privates, does not indicate that there is a serious shortage of dentists yet, nevertheless, that shortage exists and will certainly become more acute if and when an expansion comes in the armed forces of the country.

Looking forward to this time, steps have been taken to form a Procurement and Assignment Agency of the Federal Government, which agency will act to obtain and properly place the needed professional personnel.

At the Annual Convention of the American Medical Association, held in Cleveland, Ohio, in July, 1941, a resolution was passed recommending the establishment of such an agency. Motivated by this resolution, the Sub-committee on Medical Education of the President's Health and Medical Committee made the following recommendation:

"It is recommended that plans be formulated in the case of a national emergency to create a central authority to be known as a Procurement and Assignment Agency for physicians and dentists for the Army, Navy, Public Health Service, Selective Service, Civilian and Industrial needs of the Nation."

Under date of October 22, 1941 at the request of the Health and Medical Committee, the Chairman and Secretary of the Committee on Dental Preparedness attended a meeting of the Health and Medical Committee to consider the proposal for the establishment of a Procurement and Assignment Agency for dentists, physicians and veterinarians. At this meeting, in addition to the Health and Medical Committee, which includes the three Surgeons General of the United States, there were present Mr. Paul V. McNutt, Federal Security Administrator, other governmental officials and official representatives of the American Medical Association.

The Chairman of the Health and Medical Committee explained that the seriousness of the national emergency made it imperative that some action should immediately be taken to insure that adequate dental and medical personnel be made available for the armed forces and civilian population and that in all probability it would be necessary to secure legislation to accomplish these results. It was brought out that Mr. McNutt had held preliminary discussions with appropriate people in Washington and had asked the Health and Medical Committee to proceed with the drafting of the legislation necessary for translating the objectives of the resolution into effective action. This proposed legislation was to be in the form of a miniature Selective Service Act whereby dentists and physicians in certain age brackets would be required to register and would be subject to conscription for service in government activities.

The complete subject of the dental and medical problem was thoroughly discussed, and while at first it seemed that action would be taken looking toward the securing of this legislation, the dental and medical association representatives insisted that an opportunity be granted to American dentistry and medicine to secure the objectives by voluntary procedure. This view eventually prevailed and a motion was

adopted creating a committee to study the problem and to make recommendations to the Health and Medical Committee at a later date.

The personnel of this special committee was announced on the evening of October 22, 1941 and was as follows: Frank H. Lahey, M.D., Boston, Mass.; C. Sidney Burwell, M.D., Boston, Mass.; Clarence Selby, M.D., Detroit, Mich.; Morris Fishbein, M.D., Chicago, Ill.; Harvey B. Stone, M.D., Baltimore, Md., and C. Willard Camalier, D.D.S., Washington, D. C.

Because of the urgency of the situation a meeting of this special committee was called for October 28, 1941. Since this date conflicted with the activities of the annual session of the American Dental Association, held in Houston, it was impossible for the dental representative on the special committee to be present. In his stead, dentistry was represented by Dr. Leuman M. Waugh, a member of the Dental Preparedness Committee.

Out of the deliberations of this special committee came the following resolution:

RESOLUTION

That an Office of Procurement and Assignment of Physicians, Dentists and Veterinarians be established.

That this Committee offers the following suggestions as to the auspices under which this agency shall function:

The Committee would prefer that this be an independent office, set up under the Office for Emergency Management.

If, however, it should seem that there would be unnecessary delay, or administrative difficulties in making possible such an establishment, the next choice would be that it shall function as part of the Office of Defense, Health and Welfare Services which is itself a part of the Office for Emergency Management.

The Office of Procurement and Assignment shall consist of a board of five, a chairman and four members.

This board shall be chosen from members of the medical, dental or veterinary professions and shall not include any salaried governmental federal employees. This board shall function without salary.

The function of the board shall be to procure personnel from exisiting qualified members of the professions concerned. The board shall receive from various governmental and other agencies requests for medical, dental and veterinary personnel. These requests shall indicate the number of men desired, the time during which they must be secured, the qualifications of and limitations placed upon such personnel. The board may then by appropriate mechanism arrange to secure lists of professional personnel available, utilizing such existing rosters public and private as it may find acceptable, to meet these requirements. It shall also be authorized to approach such professional personnel as is considered to be available and to use suitable means to stimulate voluntary enrollment.

The board shall appoint an executive secretary, who shall serve also as an executive officer without vote in its deliberations and decisions. He shall serve as a full-time employee with salary to be determined, and with such assistants as the board may determine to be necessary for carrying out its functions.

The Board shall be authorized to establish such advisory committees and subcommittees as may be necessary. These committees shall represent the various interests concerned, such as medical, dental, and veterinary professions and medical and dental schools, hospitals, etc. Members of such committees shall serve without salary, except for reimbursement for necessary expenses incurred in their work. The board shall also be authorized to request various agencies of the government using such personnel to appoint liaison officers and representatives to advise the board in carrying out its functions.

In its functions the board shall cooperate with such agencies as are now established under Selective Service as well as other federal agencies.

This resolution was presented to the Health and Medical Committee who in turn presented it to Mr. McNutt.

On October 30, 1941, Mr. McNutt wrote the following letter to the Presi-

dent wherein he recommended the suggestion which was made in the resolution:

FEDERAL SECURITY AGENCY
Washington

October 30, 1941

My dear Mr. President:

The coordination of the various demands made on the medical, dental and veterinary personnel of the Nation and the most efficient utilization of this personnel would seem to require the establishment of a special agency capable of recording the qualified personnel available, of assigning or encouraging enlistment of such personnel in the services where most needed and of giving every qualified physician, dentist and veterinarian an opportunity to enroll himself in some service demanded by the national need.

For the above reasons I wish to propose that there be established as one of the principal subdivisions of the Office of Defense Health and Welfare Services, an office for the procurement and assignment of physicians, dentists and veterinarians. This office would be known as the Procurement and Assignment Agency.

The functions of the Agency would be: (1) to receive from various Governmental and other agencies requests for medical, dental and veterinary personnel; (2) to secure and maintain lists of professional personnel available, showing detailed qualifications of such personnel; and (3) to utilize all suitable means to stimulate voluntary enrollment, having due regard for the overall public health needs of the Nation, including those of Governmental agencies and civilian institutions.

The Agency would consist of a board of five members, one of whom would serve as Chairman. The board would serve without salary, but would be entitled to actual and necessary transportation, subsistence and other expenses incidental to the performance of its duties.

A full-time executive officer (with salary to be determined) would be appointed, together with such assistants as would be required to carry out the functions of the Agency.

I recommend that the board be composed of:

Dr. Frank Lahey, Chairman
Dr. James E. Paullin
Dr. Harvey B. Stone
Dr. Harold S. Diehl
Dr. C. Willard Camalier

This communication is addressed to you in accordance with provisions contained in paragraph 4 of the Executive Order, dated September 3, 1941 "Establishing the Office of Defense Health and Welfare Services in the Executive Office of the President and Defining Its Functions and Duties," to the effect that the President shall approve the establishment of the principal subdivisions of the Office of Defense Health and Welfare Services and the appointment of the heads thereof.

In the event you approve the establishment of the Procurement and Assignment Agency, together with the board membership as recommended above, I shall proceed immediately with the creation of the Agency, and will prepare budget estimates in the amount of approximately $50,000 for submission to the Budget Bureau to cover the costs of the Agency.

In addition I would propose to instruct the Agency to draft legislation which may be necessary to submit to the Congress providing for the involuntary recruitment of medical, dental and veterinary personnel, in the event the exigencies of the national emergency appeared to require it.

Sincerely yours,
PAUL V. MCNUTT,
Administrator.

The President
The White House
Washington, D. C.

President Roosevelt approved the proposal and accordingly the personnel of the Procurement and Assignment Agency was named on November 1, 1941. It is as follows: Frank H. Lahey, M.D., Boston, Mass.; Harold S. Diehl, M.D., Minneapolis, Minn.; James E. Paullin, M.D., Atlanta, Ga.; Harvey B. Stone, M.D., Baltimore, Md., and C. Willard Camalier, D.D.S., Washington, D. C. On these men will fall the responsibility of executing the duties pertaining to the Procurement and Assignment Agency.

On November 6, 1941, the Agency held its first meeting. Subcommittees

were established to consider various detailed problems which will arise out of the functioning of the main committee. An office for the Agency will be established in Washington and regional offices will be set up in Chicago where close access may be had to available information from the American Dental Association and the American Medical Association. A Committee on Information was established in order to keep the professions informed concerning developments and also to provide the public with necessary facts regarding this service.

It is to be noted that this Agency has been established on the basis of voluntary action on the part of professional men. This was done only after a prolonged discussion. Since it has been established on this basis it remains for the professions to demonstrate their willingness to cooperate. Attention should be called, however, to the last paragraph of Mr. McNutt's letter to the President, wherein he suggests that preparation be made for legislation leading to "involuntary recruitment of medical, dental and veterinary personnel." This can mean but one thing, that is, the establishment of the miniature Selective Service System applicable to dentists, physicians and veterinarians only which was mentioned earlier in this report. If such a system is established it can and will work many hardships on our dental personnel.

The Preparedness Committee is making every effort to cooperate with the Federal Government in such a way as to work the least hardship on the profession as a whole, but, without the cooperation of the profession, this cannot be effectively done.

To assist the Procurement and Assignment Agency, the American Dental Association will need all available statistics concerning the profession, and these statistics can only be gathered by means of the Preparedness Questionnaire. To date there are still approximately 25 per cent of the dentists of the United States who have not completed a questionnaire, and if this 25 per cent does not cooperate, then we can expect nothing but legislation which will force cooperation. It is important that all dentists, regardless of age or governmental connection, complete this questionnaire, since it is in this way only that statistics covering the entire profession can be obtained.

Any dentist who does not have a copy of the questionnaire may obtain one by addressing the American Dental Association at 212 East Superior Street, Chicago.

C. WILLARD CAMALIER, *Chairman,*
GERALD D. TIMMONS, *Secretary,*
Dental Preparedness Committee.

LEGISLATIVE COMMITTEE

LIABILITY OF DENTIST FOR POSTOPERATIVE INFECTION

By LESLIE CHILDS, Indianapolis, Ind.

THE tendency of patients to place the blame for postoperative infections upon their dentists is illustrated in a long line of cases. But since each case of this kind has necessarily turned upon its facts and circumstances, the subject of liability cannot be covered by any hard and fast rule.

However, generally speaking, in actions of this character, the burden will rest upon the patient to show negligence on the part of the dentist, and that such negligence was the direct cause of the alleged injury. In other words, the mere fact of postoperative infection will not render the dentist liable therefor.

INFECTION FOLLOWS EXTRACTION

In Morris *vs.* Weene, 258 Mass. 178, 154 N.E. 860, the plaintiff had for some days been suffering from an impacted wisdom tooth. He applied to the defendant, a dentist, for treatment. The latter, after taking an x-ray picture, advised that the tooth be extracted. This was done and the extraction was followed by somewhat profuse and continued bleeding.

Upon the advice of the defendant, the plaintiff used antiseptics, but, soon after the operation, his face began to swell and be painful. On the morning of the following day, the plaintiff consulted a physician. The latter administered treatment that, among other things, stopped the bleeding. The same day, the defendant called upon the plaintiff and stated that the bleeding should not have been stopped. The defendant continued to treat the plaintiff for several days thereafter, stating that the plaintiff's jaw was infected.

Thereafter, the plaintiff brought the instant action against the defendant for damages, on the ground of negligence of the defendant in the extraction of the tooth and the after treatment. Upon the trial, the plaintiff appears to have relied for recovery upon the fact of postoperative infection, for he introduced no evidence of negligence on the part of the defendant. However, a jury found for the plaintiff. The defendant appealed, and the higher court in sustaining his exceptions reasoned, in part, as follows:

There was no evidence of the defendant's lack of skill in the extraction of the tooth or in the use of antiseptics, and no evidence was offered to show that his implements were not properly sterilized and cared for, or that he failed to do anything which should have been done to prevent the infection. The plaintiff's evidence went no further than to show that infection might have been caused by the defendant, and it was equally consistent with an inference that its cause was the introduction of a germ for which the defendant was in no way responsible.

In this state of the evidence the rule applies that if causes other than the negligence of the defendant might have produced the injury, the plaintiff is "bound to exclude the operation of such causes by a fair preponderance of the evidence." . . .

In stating the rule to be applied herein, the court quoted from another case:

If on all the evidence it is just as reasonable to suppose that the cause is one for which no liability would attach to the defendant as one for which the defendant is liable, then a plaintiff fails to make out his case. . . .

Exceptions sustained. Judgment for defendant.

A like conclusion was reached in McTyeire *vs.* McGaughy, 222 Ala. 100, 130 So. 784:

The plaintiff, suffering from an infected tooth, went to the defendant, a dentist, for treatment. After extraction of the tooth, the infection spread to the plaintiff's jaw and face, and, as a result, the plaintiff suffered great physical pain and discomfort.

The plaintiff sued the defendant, alleging negligence on his part in treating her. Upon the trial, this charge was not sustained. On the other hand, the defendant introduced evidence that he had sterilized his instruments before operating and had followed the method usually employed by dentists in that community in treating cases of this kind.

The case went to a jury, and, as in the case reviewed above, the jury found for the plaintiff. On appeal, however, the court in reversing the judgment on the verdict of the jury, among other things, said:

It is well settled that the doctrine of *res ipsa loquitur* does not apply in cases such as this and the burden of proof is not shifted by showing painful or unfortunate consequences attending and following the treatment or operation by a physician or surgeon. . . .

The evidence is clear to the point that the infection in the plaintiff's jaw was not the result of any negligence on the part of the defendant, and that the defendant was entitled to have the jury so instructed. . . .

After allowing every reasonable presumption in favor of the correctness of the verdict, we are clear to the conclusion that the preponderance of the evidence against the verdict is so decided that it should not be allowed to stand, and that the trial court erred in overruling the motion for new trial. . . . Reversed and remanded.

In the foregoing cases, the evidence was held insufficient to render the defendant dentists liable for postoperative infections. In the following cases, the evidence was held sufficient for this purpose. United Dentists Inc. *vs.* Byran, 158 Va. 880, 164 S.E. 554, comes to mind.

FACTS IN THE CASE

The defendant, a dentist, extracted a third molar tooth for the plaintiff. At this time, there was no indication of infection, but an infection developed the next day, necessitating an operation and hospital treatment. The plaintiff sued the defendant for damages, alleging negligence on his part in the extraction of the tooth, and, in particular, stating that his instruments were not properly sterilized. The following excerpt from the report is illustrative of the trend of the plaintiff's evidence on this point:

The evidence also discloses that the defendant kept the solution of alcohol which was used for sterilizing the needle in a half-pint milk bottle; that the entire needle could not be completely immersed in the alcohol because the milk bottle was not of sufficient size to permit its entry, and as a result the handle portion of the needle was not immersed in the solution at all. It was also shown that the inside of the needle was not sterilized at all. . . .

The defendant contended that the evidence fell short of showing that any negligence on his part caused the infection; that it was not shown to have resulted from his use of his instruments to the exclusion of the possibility that it arose through some other agency. A jury, however, found for the plaintiff for $650, and the higher court in affirming a judgment thereon, in part, said:

When we refer to the evidence, we find that no infection existed prior to the operation, and after the operation the cavity or socket was not infected. There was never any infection in the cavity. The infection began and centered where the needle was injected in the gum. This evidence is not controverted. In any event, in this case, whether the infection directly resulted from the use of unclean instruments was peculiarly a question for the jury.

In cases of this nature, a plaintiff, in his proof, is not required to exclude every pos-

sibility that the injury might have been caused through some means for which the defendant is not responsible. All that is required of the plaintiff is that he prove his case by a fair preponderance of the evidence. . . . Affirmed.

The subject here under consideration was passed upon in Bennett *vs.* Fitzgerald, 284 Mass. 535, 188 N.E. 247. The defendant operated a dental office and employed a number of dentists. One of the latter extracted an aching tooth for the plaintiff. Infection followed, culminating in osteomyelitis, calling for a surgical operation to remove a part of plaintiff's jaw bone. The plaintiff sued for damages, alleging negligence on the part of the defendant's employe. Summarized from the report, the plaintiff's evidence was as follows:

There was no redness or swelling. As a preliminary, the dentist prepared to inject a local anesthetic. . . . He wore no gloves, and he sterilized the needle only by passing it through a flame. He did not sterilize the gum. . . .

On the third or fourth insertion in the gum, the needle broke off. It had to be extracted by means of a long instrument, which the dentist took out of a drawer and used "to dig down into the gum and feel around there and get it and pull it out." Nothing was done with that instrument before it was used; he just took it out of the drawer. Then he injected some fresh anesthetic with a new needle and extracted the tooth, which showed no abscess or decay.

In the light of the foregoing, an expert witness for the plaintiff testified, in part, as follows:

In osteomyelitis, redness and swelling over the part infected come within a few hours or a few days after the original infection. Before injecting a local anesthetic, the gum should be dried and tincture of iodine or other sterilizing agent should be applied. . . .

The needle also should be sterilized and kept sterile until it is used. . . . A needle cannot be thoroughly sterilized merely by passing it through a flame. In extracting a broken needle from the gum, it is necessary to use sterile instruments in order to prevent infection. . . . It was reasonable to believe that the dental treatment already described caused the disease.

On the foregoing record, a jury awarded the plaintiff a verdict, and the higher court on appeal in approving the verdict said:

Upon the evidence . . . the jury could find that the defendant's servant negligently omitted ordinary proper precautions. . . . The jury could find also that his negligence was the cause of the disease from which the plaintiff suffered. . . . Judgment for the plaintiff on the verdict.

CONCLUSION

As has been noted, there are many cases dealing with the liability of dentists for injuries resulting from post-operative infection. And while the patient has the burden of showing negligence on the part of the dentist as the proximate cause of the infection, this does not have to be shown to an absolute certainty, but rather only by a preponderance of the evidence.

These cases, then, are usually fact cases, and each will necessarily turn upon its facts. Consequently, general rules as such have little application. However, this in no way detracts from the value of the cases reviewed as fair illustrations of judicial reasoning under varying facts, on the subject involved.

RECENT DECISIONS

MALPRACTICE: SKILL, CARE AND JUDGMENT

THE plaintiff, who was the mother of the injured person, since deceased, brought a suit for damages against the defendant dentist, alleging that her son had visited the defendant's office and consulted with him regarding a loose tooth root, on examination of which the defendant advised immediate extraction. The plaintiff further alleged that the defendant did extract the tooth, but that he did not exercise that degree of care which any prudent dentist would have shown under similar circumstances in that he failed to take x-ray films; and failed to use sanitary, clean and sterilized instruments in the probing and extraction of the root, and that although he discovered immediately after the extraction that the plaintiff's son was suffering from necrosis of the mandible and was in great danger of infection and blood poisoning, he failed to send him to have the cavity properly curetted and failed to curet the cavity himself, but, on the contrary, negligently permitted him to develop a systemic infection, from which he died. The defendant's reply to these charges was that they did not constitute a basis for a charge of malpractice and the lower court sustained this reply. The plaintiff took exception to this ruling and appealed to the Court of Appeals.

The Court of Appeals first stated that the law requires a person practicing dentistry for compensation to bring to the exercise of his profession a reasonable degree of care and skill. Furthermore, stated the court, the dentist is also under a duty to give such after treatment to the patient as the necessity of the case demands, in the absence of any special agreement to the contrary. Applying the foregoing state of the law to the fact stated in this petition, namely that the defendant was negligent in failing to take x-ray films, use sterile instruments, curet the cavity or send the patient to a hospital for treatment, a question of fact was presented as to whether the defendant was guilty of such gross error of judgment as to amount to failure to exercise the requisite care and skill toward the patient, and the lower court erred in sustaining the defendant's objection to the sufficiency of the petition. Judgment reversed.—Specht *v.* Gaines, 16 S.E. 2d 507 (Georgia, 1941).

MALPRACTICE: FAILURE TO TAKE X-RAY FILMS OF FRACTURE AS EVIDENCE OF NEGLIGENCE

THE plaintiff, a child aged 5, brought an action for personal injury through her mother. The defendants were charged with the negligent and incorrect setting of the plaintiff's arm, leaving the arm weak, disfigured and at an awkward angle, and subjecting the plaintiff to intense pain and suffering. The jury returned a verdict in favor of the plaintiff and the defendants took an exception to the overruling of their motion for a new trial.

In its opinion, the court stated that the jury was authorized to find that the failure of the defendants to follow the progress or lack of progress in the healing of the broken arm by the use of x-rays, for more than five weeks, was

negligence on their part. The x-rays were an available and well-known instrumentality which, if used, would have shown in time to correct it the one of three things which the expert testified could have caused the misangulation. The three possible causes were improper setting, a slip after a proper setting or, if the bone was properly set, a knitting of the break so irregularly as to cause a misangulation. Any one of the three if not corrected before the healing of the break would result in deformity, and the failure to use x-rays to determine which one had occurred was not a mere error of judgment, but negligence in not obtaining the available proper data before proceeding with the treatment. The jury was also justified in finding that the failure to employ the x-rays, an available and well-known means for obtaining such data, was a lack of ordinary care and diligence on the part of the defendant doctors. Judgment affirmed.—Howell *v.* Jackson, 16 S.E. 2d. 45 (Georgia, 1941).

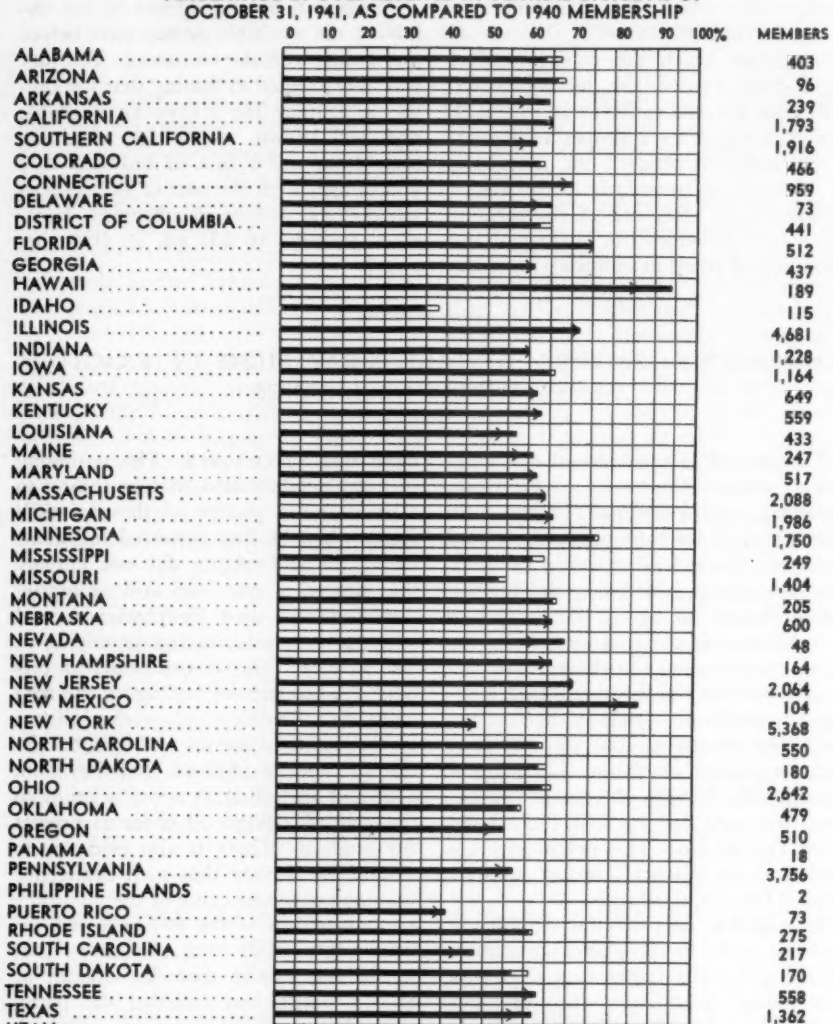
MALPRACTICE: FAILURE TO TAKE X-RAY FILMS OF FRACTURE AS EVIDENCE OF NEGLIGENCE

THE plaintiff was employed as a body welder and, in the course of his work, sustained deep lacerations of the little finger and a fracture of the proximal phalanx. The defendants were called to treat the injury, which they did for two weeks before taking an x-ray picture and discovering the fracture. After the x-ray examination, the defendants continued to treat the injury without making any attempt to reduce the fracture for about ten days. The plaintiff then went to another physician. The plaintiff subsequently brought an action for negligent treatment and was awarded a judgment for $6,000. The defendants appealed to the District Court of Appeals, Second District, California.

It was the duty of the defendants, said the court, to apply to the treatment of the plaintiff's finger that degree of care, skill, knowledge and attention ordinarily possessed by practitioners of the medical profession under similar circumstances in the locality where treatment was administered. The testimony of experts established that in failing to take an x-ray picture of the plaintiff's finger when he first appeared for treatment, the defendants did not employ that degree of care and skill ordinarily possessed and used by physicians and surgeons in good standing practicing in the locality. The record contains evidence to support the finding by the trial court that the defendants were negligent in failing to discover and reduce the fracture and, in addition, that they were negligent in failing to apply a splint to the plaintiff's finger in order to protect the tendons. There is also evidence to sustain the finding that such negligence was the proximate cause of the plaintiff's permanent loss of the ability to flex his little finger. The court also stated that it did not believe that the amount of $6,000, which was awarded the plaintiff, was excessive. Judgment affirmed. Smith *v.* Coleman, 116 P. 2d 133 (Cal. 1941).

Membership Page

PERCENTAGE OF DUES RECEIVED IN CENTRAL OFFICE AS OF OCTOBER 31, 1941, AS COMPARED TO 1940 MEMBERSHIP



Percentage based on dental population figures supplied by the State Society Secretaries

1941 percentage. 1940 percentage.

OBITUARIES

JESSE DUNCAN WHITE, D.D.S. (1873-1941)

JESSE DUNCAN WHITE, for more than forty years a leader in dental education and association work, died at Barnes Hospital, St. Louis, Mo., September 16.

He was born July 17, 1873, in Raymond, Ill., the son of Ormand and Elizabeth Duncan White. He was educated in the public schools of Litchfield, Ill., and in 1892 enrolled in the School of Dentistry, Indiana University, Indianapolis, then the Indiana Dental College. After one year at this school, he transferred to the Missouri Dental College, St. Louis, where he completed the 1893-1894 term. After the second year of his dental education, he attended courses in dental prosthesis in an Indianapolis private school conducted by Dr. G. B. Martin. From 1894 to 1900, he practiced dentistry in Illiopolis, Ill., returning to Washington University Dental School, St. Louis, in 1900, where he received the degree of D.M.D., in 1901. Upon graduation, he went to Springfield, Ill., where he conducted a successful practice until 1904. The urge to improve his technical skill caused him to attend the Haskell Post Graduate School of Chicago in 1904. Thereafter, he was called to Washington University Dental School to assume the duties of instructor in ceramics and crown and bridge prosthesis. He served as associate professor and later as professor in this department of the school until his retirement in 1936. He was dean of the school from 1932 to 1936.

Dr. White was a life member of the St. Louis Dental Society and its president in 1912. He was also a life member of the Missouri State Dental Association and its president in 1915-1916. He became active as a member of the American Dental Association in 1908, giving lectures on dental prosthesis at most of its annual meetings. He was an honorary member of many dental societies and a charter member of the honorary dental organizations of Omicron Kappa Upsilon and the American College of Dentists. He served as vice-president of the Supreme Chapter, Omicron Kappa Upsilon from 1923 to 1929. He was a member and past president of the National Alumni Association of Xi Psi Phi Fraternity; of

JESSE DUNCAN WHITE, D.D.S.

the St. Louis Society of Dental Science; of the University Club, St. Louis, and of the University City Lodge of Masons.

Throughout his professional life, Dr. White gave freely of his time as a lecturer and clinician, appearing before dental societies in all parts of the United States and before the American Dental Society of Europe.

He was respected and beloved by all

who knew him. His fine character and unswerving professional ethics gained for him the esteem of his fellows and the devotion of a large clientele. He was an inspiration to many students as well as graduates in dentistry and contributed to the success in practice of a large number. Always cordially received, dentists and dental students who asked for aid, professionally or financially, were generously helped, never refused.

In 1937, the Alumni Association of Washington University Dental School placed a bronze plaque of Dr. White in the dental school.

Dr. White married Consuella M. Cowden, of Illiopolis, Ill., in 1898, who survives with two children, Donald C. White, D.D.S., and Dorothy White Thomas, of Houston, Texas.

J. F. A.

HARRY G. CHAPPEL, D.D.S.
(1868-1941)

HARRY G. CHAPPEL was born in Wing, England, March 22, 1868. He died at his residence, 492 Staten Ave., Oakland, Calif., after a nine months' illness, September 13, 1941.

Dr. Chappel studied dentistry at the University of California. He graduated in 1896, and practiced dentistry continuously in Oakland until his retirement, in 1927. As a student, he was beloved by his classmates and respected and honored by his professors. He was a member of Iota chapter of Xi Psi Phi fraternity.

Dr. Chappel served his profession faithfully, with an untiring effort to advance and improve it. He was president of the Alameda County Dental Society in 1902 and of the California State Dental Association 1911-1912. He was a member of the Committee of Organization of the Panama Pacific Dental Congress in 1915, and also served on the board of directors of the congress. It was due chiefly to his indomitable spirit of achievement that the California Study Club, which he served as president for twenty years, was organized. Along the entire West Coast, dentistry was benefited by the ceaseless efforts of the club to disseminate the principles advanced by G. V. Black.

When his health permitted, Dr. Chappel was in regular attendance at all dental meetings of importance. His gentle manner and nobility of soul won friends for him everywhere. He was always a student and he especially enjoyed the study of botany, devoting a great deal of attention to the California flora. He was familiar with the wild flowers of this and many other countries. While in dental practice, he took up the study of zoology and paleontology at the University of California, making an exhaustive study of the skulls of the ancient native Hawaiians in the Bishop Museum in Honolulu. His findings were published by the Museum.

Dr. Chappel was a member of the Outlook Club and a charter member of the Oakland Business Men's Garden Club. He was a former member of the American Association for the Advancement of Science. He was a member of the First Congregational Church of Oakland and for many years conducted the adult Bible class of that church.

Surviving are Mrs. Chappel, a stepson, Arthur L. Cunningham, and two half-sisters, Mrs. Ida Colby and Mrs. Louie Spires, all of Oakland.

WALTER R. HUGHES.

H. R. C. WILSON, D.D.S.
(1881-1941)

HARRIS REID COOLEY WILSON, director of mouth hygiene in the Cleveland (Ohio) Public Schools, died July 9, 1941.

Dr. Wilson was born in Painesville, Ohio, September 7, 1881. He acquired his early education in the Cleveland Public Schools, Western Reserve Academy, Hiram College and the Case School

of Applied Science. He received his dental degree from Western Reserve University, School of Dentistry, in 1905. Immediately after graduation, he associated himself with his father, George H. Wilson, in Cleveland, where, over a period of twenty years, he developed a large clientele. At the time that he entered practice, his father was chairman of the first mouth hygiene committee appointed by the Cleveland Dental Society. Inspired by the altruistic interests of his father and an uncle who was director of city charities, it was quite natural that Harris Wilson should devote himself to the mouth hygiene movement. In 1909 and 1910, he was secretary of examinations covering 21,000 school children.

In 1910, Dr. Wilson took an active part in the Marion School experiment conducted by William G. Ebersole. This was the first practical mouth hygiene demonstration, which proved to the dental profession of the world the vital part hygiene of the mouth played in the physical and mental well-being of the child.

In 1912, Dr. Wilson gave generously of his time in organizing the National Mouth Hygiene Association. In the following year, the Cleveland Auxiliary of the National Mouth Hygiene Association was formed. In March 1915, Dr. Wilson succeeded Dr. Ebersole as secretary-treasurer of the Cleveland Mouth Hygiene Association. At this time, six dental dispensaries were in operation in the public schools. Under Dr. Wilson's supervision, a similar service was developed in the parochial schools through the city health centers.

In 1921, Dr. Wilson was appointed supervisor of school dental clinics, a position which he retained to the time of his death. Under his direction, the program in the schools developed to a point where, in 1927, thirty-four chairs were in operation.

Dr. Wilson was recording secretary of the Cleveland Dental Society from January 1913 to May 1915; vice president in 1916, and president in 1917. As a member of the Northern Ohio Dental Association, he served on the executive committee for three years and was president in 1926. He was a member of the American Public Health Association and in 1927 was honored with a fellowship in the association. In 1938 he became a fellow of the American College of Dentists. In 1929, he published a book on "The History of Mouth Hygiene in Cleveland." This was followed by a "Survey of Mouth Hygiene Programs for Children in 376 cities." In June 1927, "The Function of the Dentist in School Health Procedure" was published in the *American Journal of Public Health* "The Rôle of the Pay-Cost Clinic" appeared in the same journal in September 1931.

Dr. Wilson always maintained his interest in civic affairs. He was a member of the chamber of commerce for a number of years, devoting considerable time to the committee on public health. He was a member of the Cleveland City Club and of the Foreign Affairs Council of Cleveland. In 1931, he served on President Hoover's Child Health Conference as a member of the Committee on the School Child.

Dr. Wilson's life was devoted to his profession. His mouth hygiene accomplishments were an outstanding contribution to society. He never faltered in his determination to provide mouth hygiene service for the children of Cleveland. Many children will live happier and healthier lives because of his efforts.

E. A. EKLUND,
H. F. HESS,
GUY S. LERCH, *Chairman.*

QUESTIONS AND ANSWERS

The answers here published have been prepared by competent authorities, but do not, however, represent the opinion of the American Dental Association as an organization or of any other official bodies unless specifically stated in the reply.

REBASING DENTURES

To the Editor: I should like to know how to proceed in this case: A patient wants an upper denture rebased and a lower made over, using the same teeth for the lower. I proceeded in this way: For the upper case, I used "plastogum," leaving the denture in till I secured the wax bite of the lower. Now, how should I proceed to attach to the articulator and set up the lower teeth?

W. R. Russell, D.D.S.,
Stockton, Ill.

ANSWER

To complete the work as it has been started, the upper denture containing the rebase impression in which an artificial stone cast has been made should be mounted in the articulator by means of a facebow record. The facebow record should be made before pouring the cast. The lower cast is mounted in the articulator by means of the centric relation record made on the lower occlusal rim. A protrusive jaw relation record should then be made from the patient and used to adjust the condyle elements of the articulator. The lower teeth are arranged to occlude with those on the upper denture. The finished set-up should, of course, be in balanced occlusion, but unless the dentures were in such occlusion previously to starting this work, they will not be in balanced occlusion now, and it will probably be necessary to remove at least the posterior teeth from the upper denture and rearrange both the upper and the lower posterior teeth before the desired occlusion can be obtained.

It is the opinion of the writer that a case in which so many corrections are necessary would be better served and probably less expensively in the end by constructing new dentures. The patient could wear the old dentures until the work is completed.

LUZERNE G. JORDAN,
Washington, D. C.

ALLERGY TO PEPPERMINT FLAVOR

To the Editor: I would appreciate your advising me as to what toothpastes or powders on the market today do not contain peppermint, since I have a patient who is allergic to peppermint flavor.

Martin T. Shapiro, D.D.S.,
Philadelphia, Pa.

ANSWER

Apparently, a large percentage of the hundreds of dentifrices on the market contain oil of peppermint as a flavoring agent. Oil of peppermint does not appear in the statement of composition of the following dentifrices acceptable to the Council on Dental Therapeutics:

Burkes Dental Cream. Manufactured by Lactona, Inc., St. Paul, Minn.

Cow Brand Bicarbonate of Soda—Arm & Hammer Brand Bicarbonate of Soda.

McCann's Dental Powder. McCann's Dental Products, Danville, Ill.

Pro-phy-lac-tic Tooth Powder.

Pycopé Tooth Powder.

Zanol Tooth Powder. American Products Co., Cincinnati, Ohio.

It is suggested that the N.F. dentifrice, which may be made by a pharmacist, can be utilized in ordering a toothpowder made up to contain any desired flavoring

agent. The composition of the N.F. dentifrice is as follows:

Hard soap, in fine powder	50 gm.
Precipitate calcium carbonate, A.D.R.	935 gm.
Soluble saccharin	2 gm.
Oil of peppermint	4 cc.
Oil of cinnamon	2 cc.
Methyl salicylate	8 cc.
To make about	1,000 gm.

Oil of peppermint may be eliminated or may be replaced with oil of cloves to suit the taste.

H. H.

SULFATHIAZOLE AND ALLIED COMPOUNDS

To the Editor: Can you give me a list of references which I might consult regarding the use of sulfathiazole and allied sulfonamide compounds in tooth sockets immediately following extraction?

Harold A. Hunter,
Toronto, Canada.

ANSWER

The number of sulfa drugs has increased so rapidly during the past two years that not even physicians can keep their uses straight. In the July issue of *California and Western Medicine,* Lowell Addison Rantz and Windsor Cooper Cutting gave a brief review of the whole sulfonamide family, with the disease in which each drug works best. The ideal sulfa drug, they said, is still being sought. Requirements: It must be as strong as possible, without poisoning the patient.

Sulfanilamide, the parent drug, was first tried in a wide variety of bacterial infections. At present, its use is limited mainly to meningitis, erysipelas and urinary tract infections. It is easy to take, "well handled by the body and excreted without difficulty," but its use is attended by two "exceedingly common" complications: anemia and cyanosis (lack of oxygen). On the whole, it is "less effective therapeutically than other related compounds and is being supplanted by them." It is the only sulfonamide compound which can be given rectally with success.

Sulfapyridine therapy has far better results than sulfanilamide, but it is a difficult drug for the body to absorb and excrete and its ingestion also causes a "very troublesome nausea." At present, it has a narrow range of use, for sulfathiazole is equally effective and less toxic.

Sulfathiazole is "the most important sulfonamide drug in use at present." It is a powerful weapon against pneumonia, staphylococcic infections and a wide range of streptococcic infections. Resultant anemia and cyanosis are "less marked" than with the use of sulfanilamide. But sulfathiazole has other drawbacks: 1. It causes fever, skin rash and inflammation of the eyes of more severe character than other sulfa drugs. 2. It must be used for a relatively longer period of time, and thus the danger of complications is increased.

Sulfaguanidine may be of some use in dysentery and cholera, but is "decidedly in the experimental stage."

Sulfadiazine seems to be "rather nontoxic." It is "very promising at the moment and may prove to be the next step in the sulfonamide ladder." (Last week, Perrin H. Long, of Johns Hopkins Hospital, research worker with sulfa drugs, announced that this drug will be on the market by early fall. He said: "I have good reason to believe it will supplant all sulfa drugs now being used.")

L. P. A.

CASE OF PAGET'S DISEASE INVOLVING MANDIBLE, UNILATERAL

To the Editor: A woman aged about 50 with a unilaterally swollen mandible was referred for the extraction of a non-vital first molar. X-ray films, intra-oral and extra-oral, suggested permanent Paget's disease. The interesting part of this case is that the usual soft and vascular swelling gave the impression that the mandibular cortex itself

was hard. Also, there was no change in other bones. There is no known cause and no known treatment, although Thoma suggests a diet rich in vitamin D, calcium and phosphorus. The diagnosis of Paget's disease was further verified by Robert H. Ivy, of Philadelphia. The significance of its presentation is the attention called to the x-ray pictures, showing hypercementosis and a

Figure 1.

Figure 2.

cotton wool appearance of the bone, and the futility and danger of any operative procedure.

Albert F. Sontheimer, D.D.S.,
Rome, N. Y.

ANSWER

From the x-ray films and the appearance of the patient, I believe this is a case of osteitis deformans, or Paget's disease. Further studies would probably show changes in other bones. I do not advise any treatment.

R. H. IVY.

RADIOACTIVE PHOSPHORUS

To the Editor: There have been several reports on radioactive phosphorus in dentistry. What is it and how is it used?

A. P. L.

ANSWER

Radioactive phosphorus may be prepared artificially in several ways. Strong preparations may be produced by the action of deuterium ions on red phosphorus in the cyclotron. This device and others have been employed in making a large number of artificially radioactive elements. The marked phosphorus has a half life of 14 days. In suitable preparations, it may be administered by mouth or subcutaneously. Since the radioactive atom emits particles which can be detected by delicate instruments, radioactive phosphorus has been widely used to study metabolic changes in various tissues including the teeth and bones. See:

Hevesy, G., and Armstrong, D. W.: *J. Biol. Chem.*, 133:XLIV, March 1940.

Manly, M. L., and Bole, W. F.: *J. Biol. Chem.*, 129:125, July 1939.

Volker, J. F., and Sognnaes, R. F.: *J. D. Res.*, 19:292, June 1940.

Manly, R. S.; Hodge, H. C., and Van Voorhis, S. N.: *Proc. Soc. Exper. Biol. & Med.*, 45:70, October 1940.

Among other things, these studies indicate that fully formed enamel is probably not affected directly by nutritional changes. Metabolic activity in fully formed dentin is of a low order, resembling that of dense bone.

H. H.

CURRENT LITERATURE

Studies on Dental Caries. XII. Comparison of Caries Susceptibility of Various Morphologic Types of Permanent Teeth

By Henry Klein and C. E. Palmer

Epidemiologic analysis of dental examination findings on a group of approximately 6,000 school children of Hagerstown, Md., and environs, was made to determine the relative susceptibility of the several types of teeth. Differences among the teeth in the length of time that they are exposed (after eruption) to attack by caries and the number of specified teeth affected are the variables considered. The analysis reveals that the twenty-eight permanent teeth (third molars are not included in the study) tend to fall into five caries-susceptibility classes, the different types of teeth included within the single classes showing markedly similar susceptibility. The classes are, in descending order of susceptibility:

Class I. Mandibular first and second molars.

Class II. Maxillary first and second molars.

Class III. Mandibular second premolars, maxillary first and second premolars and maxillary first (central) and second (lateral) incisors.

Class IV. Maxillary canines and mandibular first premolars.

Class V. Mandibular first (central) and second (lateral) incisors and mandibular canines.—*J. D. Res.*, 20:203-216, June 1941.

J. Edward Gilda.

Reduction in Experimental Rat Caries by Fluorine

By S. B. Finn and H. C. Hodge

One hundred and thirty-five rats (Wistar strain) were divided into three groups at weaning. The first group received the Hoppert, Webber and Canniff caries-producing diet; the second group received the same diet with the substitution of commercial casein for the powdered whole milk; the third group received the latter diet with the addition of 3 mg. (about 300 parts per million) of fluorine (as potassium fluoride) daily. Each group was subdivided into three groups receiving respectively (a) cracked corn particles larger than 20 mesh only; (b) corn particles between 10 and 20 mesh, and (c) unsifted run-of-the-mill cracked corn. Rickets appearing in the rats receiving casein was promptly healed by incorporation of 2 per cent whole yeast and 2 per cent cod liver oil in the diets. Duration of feeding was 200 days. There was a high, statistically significant reduction in the average number of cavities, cusps involved and teeth lost per rat in the fluorine-fed group. Varying the size of the cracked corn had no significant effect on the caries incidence. (All the diets contained corn particles at least as large as 10 to 20 mesh; i.e., coarse corn particles.) There is evidence that fluorine limits caries progress as well as reduces the incidence of lesions. The mechanism of the inhibiting or protective action of fluorine is unknown.—*J. Nutrition*, 22:255-66, September 1941.

J. Edward Gilda.

Effectiveness of Chilled Burs in Eliminating Pain

By Bernard O. A. Thomas

Cavities were prepared in forty-three teeth of thirty-three patients by the use of chilled burs. An analysis of the results showed that twenty-four teeth (55.8 per cent) gave a sharp momentary pain response when the cold bur was first placed against the freshly cut dentin. It was found that the use of the chilled bur (1) eliminated the pain in six teeth (14 per cent); (2) reduced the pain in twenty-seven teeth (62.8 per cent); (3) did not alter pain in seven teeth (16.3 per cent), and (4) caused greater pain in three teeth (7 per cent).

The use of chilled burs diminished or eliminated pain in three of four patients (76.8 per cent). The highest temperatures varied from 102° to 118.6° F. for the unchilled burs, and from 88.8° to 95.5° F. for

the chilled burs. Histologic sections showed that the dentin pulp is unaffected by the limited local application of cold to the dentin.—*J. D. Res.*, 20:361-367, August 1941.

JAMES T. GINN.

Does the Maxilla Lack a Periosteal Membrane?

By LINDEN F. EDWARDS and PAUL C. KITCHIN

IN order to clarify the conception which occasionally appears in the literature concerning the absence of a periosteal membrane on the maxilla, gross dissection and histologic preparations of this bone were made. Illustrations, both gross and microscopic, are presented demonstrating that the maxilla is provided with a connective tissue covering, very loosely connected with the bone, and is also provided with a vascular network, and its internal layer contains fibroblasts typical of adult normal periosteum.—*J. D. Res.*, 20:341-345, August 1941.

JAMES T. GINN.

Studies on Masticatory Efficiency. IV. Mastication and Experimental Rat Caries

By REIDAR F. SOGNNAES

THE maxillary molars were extracted in twenty rats and eleven were used as controls. The animals were placed on the coarse-corn, caries-producing diet for 100 days. At the end of that time, the animals were killed and the teeth examined. In the absence of antagonistic molars, no evidence of cusp involvement or fissure caries was found in the lower molars. The reduced masticatory efficiency did not have any apparent ill effects upon growth and general health of the animals during the experimental period. The author concludes from this study that environmental factors in the mouth arising from the mastication of the coarse particles are important at least in initiating the cusp lesions in the rat.—*Am. J. Orthodontics*, 27: 552, October 1941.

JAMES T. GINN.

Distribution of Phosphatase in Gingival Tissue

By H. A. ZANDER

TISSUES for phosphatase determination were obtained by biopsy from the gingiva of twenty patients aged 12 to 54 years. The condition of these tissues ranged from clinically normal to acute inflammation. Phosphatase was found in the endothelial cells of the capillary walls of the subepithelial gingival tissues, and possibly in some connective tissue fibers. No phosphatase was found in the epithelium or in desquamated epithelial cells.—*J. D. Res.*, 20:347-353, August 1941.

JAMES T. GINN.

Observations on Induced Caries in Rats. III. Effect of Fluoride on Rat Caries and on Composition of Rats' Teeth

By F. J. MCCLURE

GROUPS of rats aged 23-25 days from sixteen to twenty-three litter mates as controls and corresponding test groups were fed a caries-producing cornmeal diet for a period of fifteen weeks. Fluorine was added in all test groups except two, via the drinking water, in concentrations of 5, 10, 50 and 100 parts per million. In these cases, it was administered as 125 parts per million in the food and as 10 parts subcutaneously.

A minimum of 10 parts per million of fluorine in drinking water gave partial protection against occlusal rat caries. Approximately 80 per cent protection resulted from both 50 and 100 parts per million fluorine in water. It is suggested that fluorine acts to inhibit rat caries by anti-enzymatic local action within the oral cavity.

The pooled molar teeth of groups of carious rats were not different from those of non-carious rats in content of ash, calcium and phosphorus and in fluorine which was deposited after tooth eruption. The post-eruptive addition of fluorine to the molar teeth of rats occurred in relatively large quantities and is regarded as occurring independently of oral enamel surface adsorption of fluoride. A significant effect of fluoride ingestion after tooth eruption on induced rat caries was not evident.—*J. Nutrition*, 22: 391-398, October 1941.

J. EDWARD GILDA.

Condition Suggestive of Threshold Dental Fluorosis Observed in Tristan da Cunha. I. Clinical Condition of the Teeth

By R. F. SOGNNAES

A CONDITION, previously unreported, suggesting a threshold degree of dental fluorosis, has been observed in the inhabitants of the

South Atlantic Island of Tristan Da Cunha. The lesions in the enamel appeared as opaque whitish areas possessing a smooth surface texture. Of 3,907 permanent teeth examined, 629, or 15.3 per cent, were affected with these "white spots," the incidence being highest in younger persons. Of 765 deciduous teeth, seventy-seven, or 10 per cent, were similarly marked. The anterior teeth, while remarkably free from dental caries, were most frequently affected with these white areas. It seems probable that the fluorine was derived from drinking water and from the large quantities of fish consumed.—*J. D. Res.*, 20:303-313, August 1941.

J. EDWARD GILDA.

Condition Suggestive of Threshold Dental Fluorosis Observed in Tristan da Cunha. II. Fluorine Content of the Teeth

By R. F. SOGNNAES and W. D. ARMSTRONG

EIGHTEEN teeth, ten deciduous and eight permanent, were used for the fluorine analyses. The deciduous teeth were obtained only from those islanders changing dentition at the time of their stay on the island. The permanent teeth were extracted only when malposition or caries justified. Consequently, the material is lacking permanent teeth with the characteristic white, opaque areas.

The average fluorine content of the enamel in both dentitions was found to be 0.0140 per cent, while the deciduous and permanent dentin contained 0.0196 and 0.0270 per cent fluorine, respectively. These values are from 27 to 60 per cent higher than those of non-fluorosed sound teeth (from Minnesota) analyzed by the same method in the same laboratory.—*J. D. Res.*, 20:315-322, August 1941.

J. EDWARD GILDA.

External Pin Fixation for Fractures of the Mandible

By R. MOWLEM, M. L. D. BUXTON, A. B. MACGREGOR and J. W. BARRON

THE authors record their developments in the use of crossed Kirschner wires as a means of approximating and holding the posterior fragment of the jaw in the absence of teeth. The latest attachment between the Kirschner wires consists of heavy aluminum alloy wire with an adjustable attachment at one end. Absolute fixation is claimed and function of the temporomandibular joint is maintained. It is occasionally necessary to treat residual scars. It should be used only where standard methods are unsuitable. Nineteen cases have been successfully treated.—*Lancet*, 2:391, October 1941.

B. G. BIBBY.

Extra-Oral Splinting of the Edentulous Mandible

By LEANDER POHL

FOR extra-oral splinting of fractures of edentulous mandibles the author employs two hooks and screws, one of which is applied on each side of the fracture. These are joined by a bar which is welded into position *in situ*. Early ability to chew and ease of further surgical treatment are offered as advantages of this procedure. One case has been successfully handled.—*Lancet*, 2:389, October 1941.

B. G. BIBBY.

Diagnosis and Treatment of Mild Vitamin Deficiencies

By J. M. RUFFIN

THE clinical signs of advanced vitamin deficiency are easily recognizable, owing to the changes in the skin, tongue, gums, mouth and gastrointestinal tract. Most laboratory procedures require special apparatus and well trained technicians. Reliable symptoms of vitamin deficiency are loss of weight, weakness, fatigability, insomnia, headache, indigestion and increased nervousness. Single vitamin deficiencies rarely if ever occur.

The author shows clearly that when irreversible intracellular changes ensue, vitamin therapy is of little value, and it is well to note that the best treatment is a well balanced diet.—*J.A.M.A.*, 117:1493, November 1941.

V. H. POWELL.

ANNOUNCEMENTS

Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of The Journal.

CALENDAR OF MEETINGS

Alpha Omega Fraternity, New York, N. Y., December 29-31.

American Association for the Advancement of Science, Subsection on Dentistry, Dallas, Texas, December 29-30.

American Association of Orthodontists, New Orleans, La., March 16-19, 1942.

Chicago Dental Society Midwinter Meeting, February 23-26, 1942.

Dallas Midwinter Dental Clinic, Dallas, Texas, January 26-28, 1942.

District of Columbia Dental Society, second and fourth Tuesdays in each month, from October to June at the United States Public Health Service Auditorium, Washington.

Dental Protective Association, Chicago, Ill., December 15.

Denver (Colo.) Midwinter Dental Meeting, January 25-28, 1942.

Five State Post Graduate Clinic, Washington, D. C., March 8-12, 1942.

University of Illinois, College of Dentistry Alumni Homecoming, Chicago, Ill., December 3.

National Board of Dental Examiners, December 1-2.

Greater New York Dental Meeting, New York, December 1-5.

North Atlantic Orthodontic Society, New York, N. Y., January 21, 1942.

Pan American Odontological Association, New York, N. Y., December 3.

Greater Philadelphia Annual Meeting, February 3-6, 1942.

STATE SOCIETIES

December

Florida, at Hollywood (8-10)

January

Rhode Island, at Providence (14-15)

March

Minnesota, at St. Paul (3-5)

STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, December 15. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

New Hampshire, at Manchester, December 15-17. Otis M. Littlefield, 913 Elm St., Manchester, Secretary.

Iowa, at Iowa City, December 15-19. Harry G. Bolks, Sioux City, Secretary.

Minnesota, at Minneapolis, December 15-20. Elmer J. Sundby, 805 Medical Arts Bldg., Duluth, Secretary.

New Jersey, December 8-13. Walter A. Wilson, 150 E. State St., Trenton, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, December 9-13. Reuben E. V. Miller, 61 N. 3rd St., Easton, Secretary.

South Dakota, at Sioux Falls, January 29-31, 1942. T. E. Burrington, Rapid City, Secretary.

Texas, at Houston, December 8-11. B. Carl Holder, 1009 Nixon Bldg., Corpus Christi, Secretary.

Wisconsin, at Milwaukee, December 15-19. S. F. Donovan, Tomah, Secretary.

ALPHA OMEGA FRATERNITY

The Alpha Omega Fraternity will hold its thirty-fourth annual convention at the Hotel Edison, New York, N. Y., December 29-31.

William Rich, *Supreme Scribe,*
575 Belleville Ave.,
Belleville, N. J.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, SUBSECTION ON DENTISTRY

The Subsection on Dentistry of the American Association for the Advancement of Science will meet in the auditorium of the Medical Arts Building, Dallas, Texas, December 29-30. The sessions will be devoted to a symposium on "The Public Health Aspects

of Dentistry, with Special Reference to Fluorine."

PAUL C. KITCHIN, *Secretary,*
Columbus, Ohio.

AMERICAN ASSOCIATION OF ORTHODONTISTS

THE 1942 meeting of the American Association of Orthodontists will be held at the Roosevelt Hotel, New Orleans, La., March 16-19, 1942. This will be a pan American congress. A special invitation is extended to orthodontists in Central and South America.

MAX E. ERNST, *Secretary,*
1250 Lowry Medical Arts Bldg.,
St. Paul, Minn.

CHICAGO DENTAL SOCIETY MIDWINTER MEETING

THE 1942 Midwinter Meeting of the Chicago Dental Society will be held at the Palmer House, February 23-26.

GLENN E. CARTWRIGHT, *President.*

DALLAS MIDWINTER DENTAL CLINIC

THE Dallas Midwinter Clinic, sponsored by the Dallas County Dental Society, will hold its fifteenth annual meeting in the Hotel Adolphus, Dallas, Texas, January 26-28, 1942. The following clinicians will present a three-day study course: Sanford M. Moose, San Francisco, Calif.; subject: "Oral Surgery and Diagnosis." Ernest R. Granger, Mt. Vernon, N. Y.; subject: "Operative Dentistry." R. O. Schlosser, Chicago, Ill.; subject: "Denture Prosthesis." Members of the Dallas County Dental Society will present table clinics. The fee for the full three-day course, including the dinner, is $15. All members of the American Dental Association are invited. 1942 membership cards should be presented on registration.

PHELPS J. MURPHEY, *Chairman,*
Publicity Committee,
Fairmount and Welborn Sts.,
Dallas, Texas.

DENTAL PROTECTIVE ASSOCIATION

THE annual meeting of the Dental Protective Association of the United States will be held at the Palmer House, Chicago, December 15, at 4 p.m. All members are urged to be present.

E. W. ELIOT, *Secretary,*
55 E. Washington St.,
Chicago, Ill.

DENVER MIDWINTER DENTAL MEETING

THE Denver Midwinter Meeting sponsored by the Denver Dental Association, will hold its thirty-fifth annual meeting in the Shirley-Savoy Hotel, Denver, January 25-28, 1942.

ALBERT P. HORTON, *Director,*
206 Metropolitan Bldg.,
Denver.

FIVE STATE POST GRADUATE CLINIC

THE annual Five State Post Graduate Clinic of the District of Columbia Dental Society will be held at the Mayflower Hotel, Washington, D. C., March 8-12, 1942.

WILLIAM D. CURTIS, *Chairman,*
Publicity Committee.

UNIVERSITY OF ILLINOIS, COLLEGE OF DENTISTRY ALUMNI HOMECOMING

THE annual Homecoming of the Alumni of the University of Illinois, College of Dentistry will be held December 3 at the college, 808 S. Wood St., Chicago. A scientific program has been arranged for the day. A complimentary lunch will be served at noon and a banquet will be given in the evening in the Illini Union Building.

M. K. HINE, *President.*

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Parts I and II, December 1-2, in schools where there are five or more candidates. For further information and application blanks, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

GREATER NEW YORK DENTAL MEETING

THE Greater New York Dental Meeting will be held December 1-5 at the Hotel Pennsylvania, New York.

WALTER A. QUINN, *Chairman,*
Press & Publication,
Room 106A,
Hotel Pennsylvania,
New York.

NORTH ATLANTIC ORTHODONTIC SOCIETY

THE fourteenth semi-annual meeting of

the North Atlantic Orthodontic Society will be held January 21, 1942, in the Hotel Pennsylvania, New York, N. Y. Members of the dental and medical professions are invited.

A. G. KRAMER, *Secretary,*
1111 E. 15th St.,
Brooklyn, N. Y.

PAN AMERICAN ODONTOLOGICAL ASSOCIATION

THE next annual dinner meeting of the Pan American Odontological Association will be held December 3 at 7 p.m., at the Hotel Pennsylvania, New York, N. Y.

RALPH HOWARD BRODSKY,
Executive Secretary,
14 E. 81st St.,
New York, N. Y.

GREATER PHILADELPHIA ANNUAL MEETING

THE Greater Philadelphia Annual Meeting, which will be a combined meeting of the Pennsylvania State Dental Society and the Philadelphia County Dental Society, will be held February 3-6 at the Benjamin Franklin Hotel.

ABRAM COHEN, *Chairman,*
Publicity Committee,
269 S. 19th St.,
Philadelphia, Pa.

FLORIDA STATE DENTAL SOCIETY

THE fifty-eighth meeting of the Florida State Dental Society will be held at the Hollywood Hotel, Hollywood, December 8-10.

WILLIAM P. WOOD, JR., *Secretary,*
442 W. Lafayette St.,
Tampa.

RHODE ISLAND STATE DENTAL SOCIETY

THE sixty-fourth annual meeting of the Rhode Island State Dental Society will be held January 14-15, 1942, at the Providence Biltmore Hotel, Providence.

WILLIAM A. MORINVILLE, *Chairman,*
22 Park Place,
Pawtucket.

BOARD OF DENTAL EXAMINERS OF CALIFORNIA

THE next examination to be conducted by the Board of Dental Examiners of California for a license to practice dentistry in California will be held in San Francisco commencing December 15 at the Physicians and Surgeons College of Dentistry for the theory portion of the examination and at the University of California, College of Dentistry for the practical portion of the examination. All credentials must be in the office of the Secretary at least twenty days prior to the date of the examination. Address all communications to

KENNETH I. NESBITT, *Secretary,*
515 Van Ness Ave.,
San Francisco.

STATE OF NEW HAMPSHIRE DENTAL BOARD

THE New Hampshire State Dental Board will hold examinations, December 15-17, at Manchester.

OTIS M. LITTLEFIELD, *Secretary,*
913 Elm St.,
Manchester.

IOWA STATE BOARD OF EXAMINERS

THE Iowa State Board of Examiners will hold its next examination in Iowa City, December 15-19, for those desiring a license as dentist or as dental hygienist. Address Harry G. Bolks, secretary of the board, Sioux City, for instructions regarding registration for examination, etc.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

THE Minnesota State Board of Dental Examiners will hold its next examination at the School of Dentistry, University of Minnesota, Minneapolis, December 15-20. For information and application, address

ELMER J. SUNDBY, *Secretary,*
805 Medical Arts Bldg.,
Duluth.

STATE BOARD OF REGISTRATION AND EXAMINATION IN DENTISTRY OF NEW JERSEY

THE State Board of Registration and Examination in Dentistry of New Jersey will hold its annual examinations commencing December 8 and continuing for five days thereafter. On application to the secretary, a copy of the requirements and rules, instruction sheet and preliminary application

will be forwarded. Any person desiring to become a candidate must file the preliminary application blank, together with the examination fee of $25 on or before September 1.

WALTER A. WILSON, *Secretary,*
150 E. State St.,
Trenton.

DENTAL COUNCIL AND EXAMINING BOARD OF THE COMMONWEALTH OF PENNSYLVANIA

THE Dental Council and Examining Board of the Commonwealth of Pennsylvania will conduct examinations in Philadelphia and Pittsburgh, December 9-13. For information and application blanks, address the Department of Public Instruction, Bureau of Professional Licensing, Dental Division, Harrisburg.

REUBEN E. V. MILLER, *Secretary,*
61 N. Third St.,
Easton, Pa.

SOUTH DAKOTA STATE BOARD OF DENTAL EXAMINERS

THE South Dakota State Board of Dental Examiners will hold its next examination for those desiring a license to practice dentistry or dental hygiene at Sioux Falls, January 29-31, 1942. Further information can be obtained from

T. E. BURRINGTON, *Secretary,*
Rapid City.

TEXAS BOARD OF EXAMINERS

THE Texas Board of Dental Examiners will hold its next examination December 8-11 in Houston. Application must be filed at least ten days prior to date of examination. For further information, address

B. CARL HOLDER, *Secretary,*
1009 Nixon Bldg.,
Corpus Christi.

STATE OF WISCONSIN BOARD OF DENTAL EXAMINERS

THE next examination will be held December 15-19 at Marquette University Dental School, Milwaukee. Applications and information may be had by writing to the secretary. Applications and required fee must be in the secretary's office by December 5.

S. F. DONOVAN, *Secretary,*
Tomah.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

THE next examination for appointment as assistant dental surgeon, U. S. Navy (lieutenant [junior grade], Dental Corps, U. S. Navy) will be held at the Naval Training Station, Great Lakes, Ill., and the Naval Training Station, San Diego, Calif., February 9, 1942. Application for this examination should be made to the Chief of the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. Applicants for appointment as assistant dental surgeon must be citizens of the United States, more than 21 but less than 32 years of age at the time of acceptance of appointment, and graduates of a class A dental school. A circular of information listing physical and other requirements for appointment, subjects in which applicants are examined and other data pertaining to salary, allowances, etc., can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C. Assistant dental surgeons are appointed in the rank of lieutenant (junior grade), Dental Corps, U. S. Navy. The pay and allowances for an officer of this rank total $2,699 a year if he has no dependents and $3,158 a year if he is married or has dependents.

LOCATIONS FOR DENTISTS

A NEED for additional dentists exists in many of the vital defense areas. These shortages have arisen because of the great increase in civilian population that has occurred during the year. At present, needs exist in a number of states in communities varying in size from small villages to large cities. A continuing increase in population will result in overtaxing the dental personnel in many other localities where at present the dentists are very near the limit of their capacities. In many of these defense areas, there are defense housing projects in which office space or living accommodations, or both, may be secured. The United States Public Health Service in cooperation with the Division of Defense Housing of the Federal Works Agency, which supervises these projects, is interested in acquainting dentists with the needs of these communities. If you are interested in securing more specific informa-

tion about localities for the establishment of practice, communicate with

THOMAS PARRAN, *Surgeon General.*

SOCIETY OF THE NEW YORK HOSPITAL LEWIS CASS LEDYARD, JR., FELLOWSHIP

THE Lewis Cass Ledyard, Jr., Fellowship was established in 1939 by a gift from Mrs. Lewis Cass Ledyard, Jr., in memory of her husband, a governor of the New York Hospital. The income, amounting to approximately $4,000 annually, will be awarded to an investigator in the fields of medicine and surgery, or in any closely related field. The recipient will be required to submit reports of his work under the fellowship, either at stated intervals or at the end of the academic year. The research work is to be carried on at the New York Hospital and Cornell Medical College. The fellowship will be available July 1 at the beginning of the academic year. Applications for the year 1942-1943 should be in the hands of the committee by December 15. It is expected that the award will be made by March 15, 1942. Application for this fellowship should be addressed to the Committee of the Lewis Cass Ledyard, Jr. Fellowship, the Society of the New York Hospital, 525 E. 68th St., New York, N. Y.

DENTAL SUPPLIES FOR GREAT BRITAIN AND CHINA

THE United States Section of the International College of Dentists is sponsoring a movement to aid the dentists of Great Britain and China by providing them with badly needed supplies, instruments and small equipment used in the practice of dentistry. These will be collected and sent abroad by the Medical and Surgical Relief Committee of America. Any member of the dental profession or dental trade who can aid in this movement by contributions of such material is asked to communicate with Mrs. Rodgers Balcom, executive chairman of the Medical and Surgical Relief Committee of America, 420 Lexington Ave., New York, N. Y.

ELMER S. BEST, *Registrar,*
Medical Arts Bldg.,
Minneapolis, Minn.

BRONX HOSPITAL VOLUNTEERSHIPS

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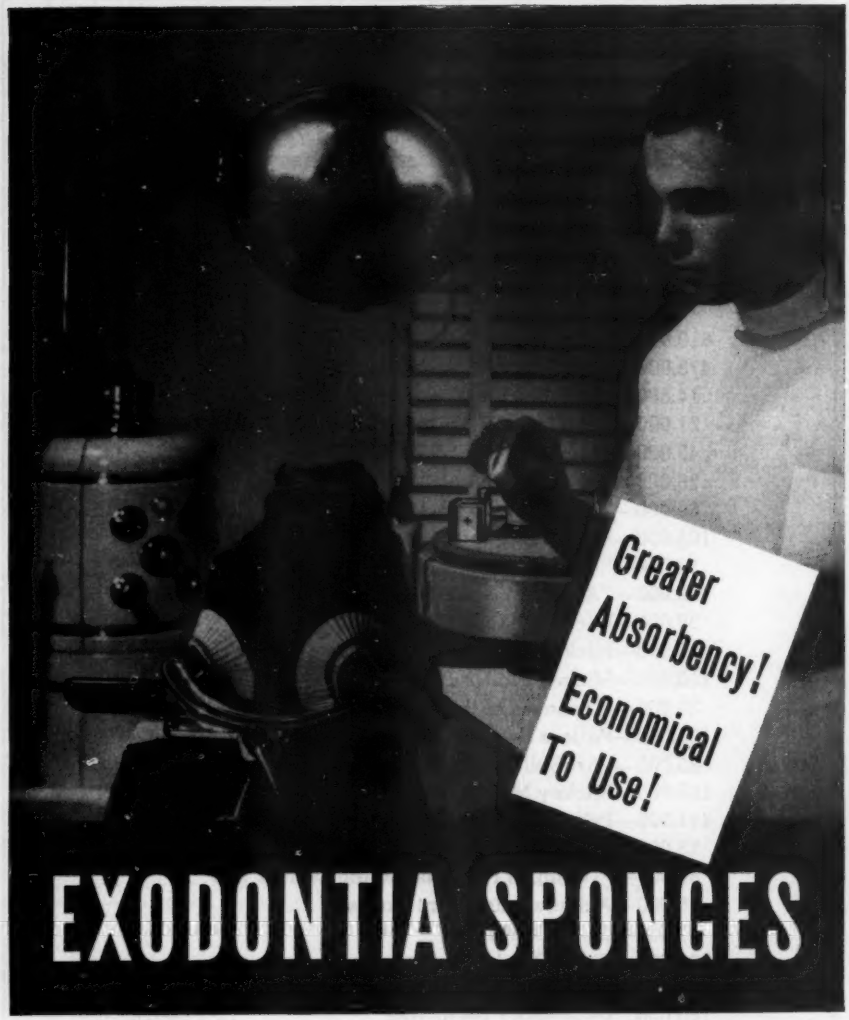

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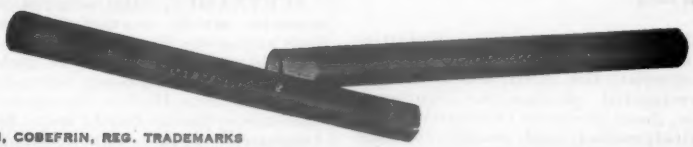

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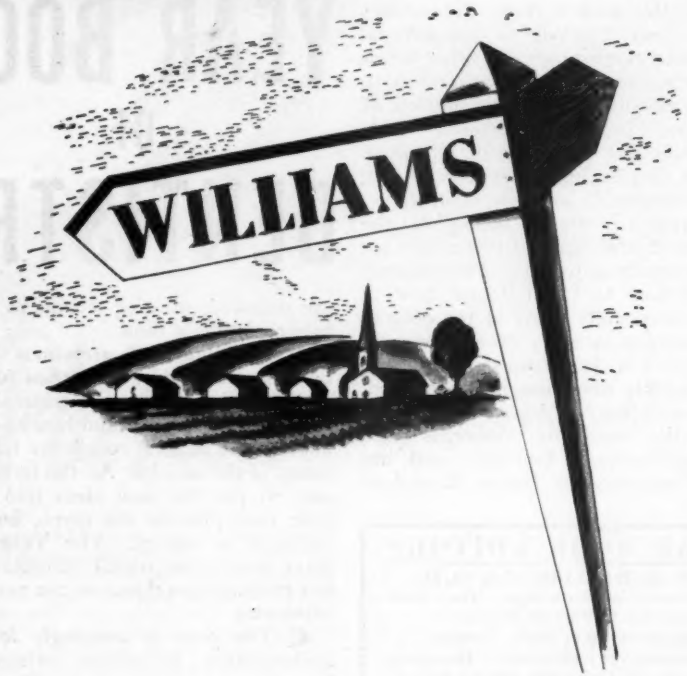

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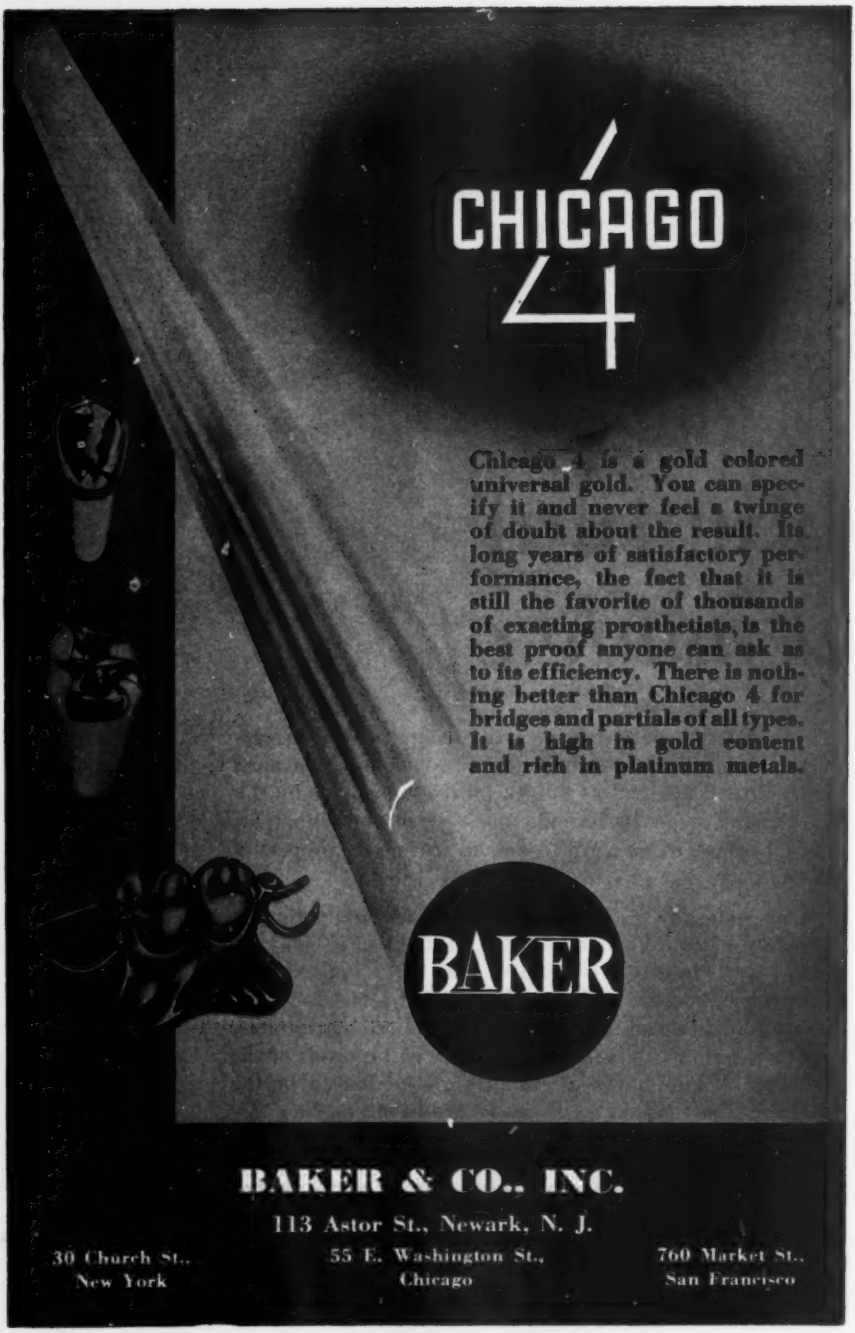
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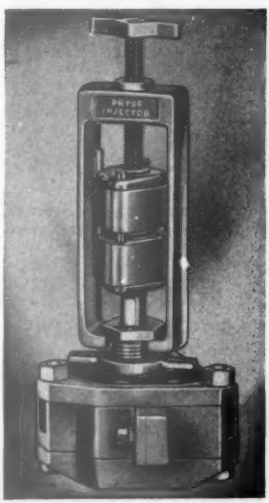

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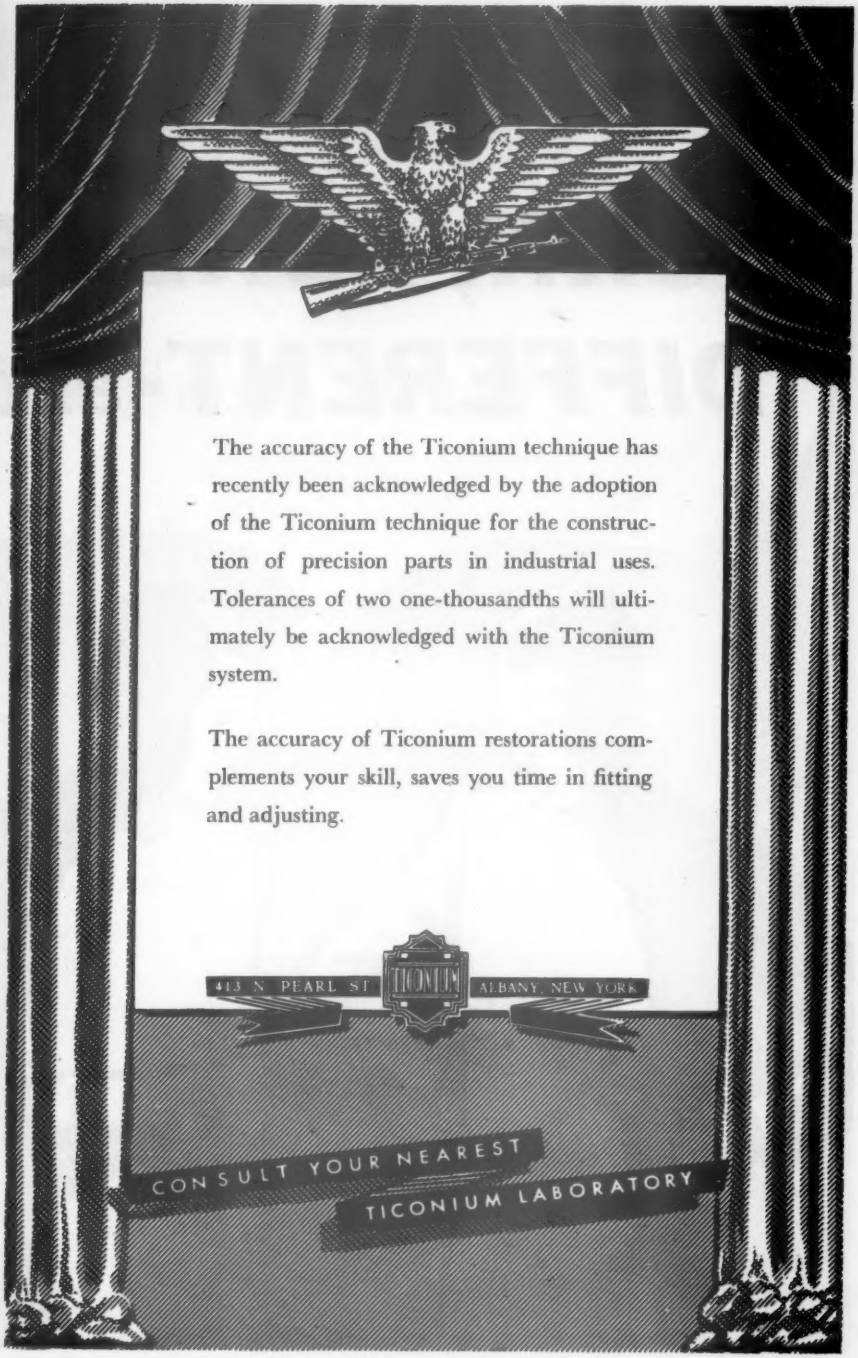
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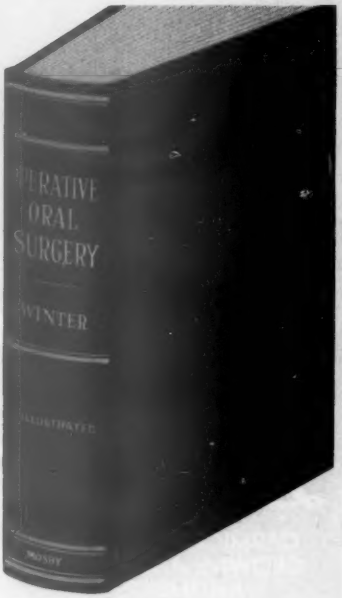

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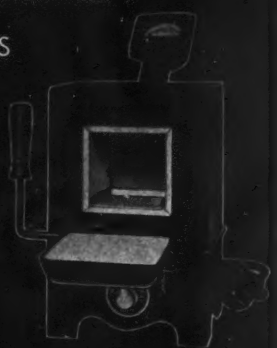

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5. Wet finger in warm water, smooth out material, insert immediately into mouth and take impression.
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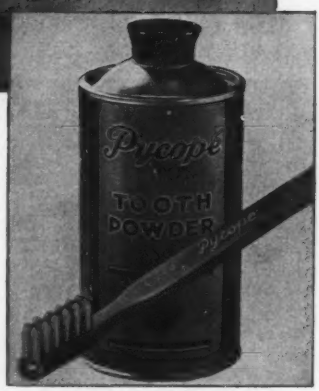

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TOOTH POWDER & TOOTH BRUSHES

The Newer Concepts of Meat in Nutrition

The Protein of
Meat and its Advantages

THE need for protein, a constituent of all living tissue, is both qualitative and quantitative. In the light of current knowledge of biologic processes, ten amino acids (of the total of thirty now identified) are regarded as nutritionally indispensable for both growth and maintenance. Since they cannot be synthesized by the organism (except arginine which is produced in an insufficient quantity), they must be derived from protein-containing foodstuffs. An inadequate intake of one or more usually leads to retarded growth in the young and to an impaired state of health in the adult, as demonstrated in experimental animals. Recent studies indicate that the optimum requirement for protein may be as high as from 80 to 100 grams daily, an amount probably not supplied in some diets.

In a recently published article* on the etiology and control of dental caries, the importance of a well balanced, adequate diet is stressed. Though irrefutable evidence is not yet at hand to establish the etiology and pathogenesis of caries, the author believes that an abundant intake of essential food constituents and vitamins, by producing an optimal nutritional state, may enable the organism more effectively to resist the influence of destructive forces upon the teeth. He advocates the use of diets which provide protective substances and food essentials in excess of the amounts usually considered just adequate, feeling that individual requirements in many patients may be unusually high.

To satisfy the daily requirement of protein, meat offers many advantages:

It is almost completely digested by children and adults.

It yields its amino acids without appreciable loss.

Its proteins, differing from those obtained from some other sources, are nutritionally adequate, supplying all known essential amino acids in quantities sufficient for growth and for tissue maintenance and repair.

It does not add undue bulk to the dietary.

Many nutritionists assert that meat should be the primary source of protein for the human organism.

*Boyd, J. D.: The Role of Diet in the Control of Dentinal Caries, J. Am. Dent. A. 27:750 (May) 1940.

The Seal of Acceptance denotes that the statements made in this advertisement are acceptable to the Council on Foods and Nutrition of the American Medical Association.

American Meat Institute
CHICAGO

AMERICAN DENTAL ASSOCIATION

OFFICE OF
DR. FRED A. RICHMOND
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HURON BUILDING
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December 1, 1941

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4 Closed Bottom of male section — easy insertion and removal.

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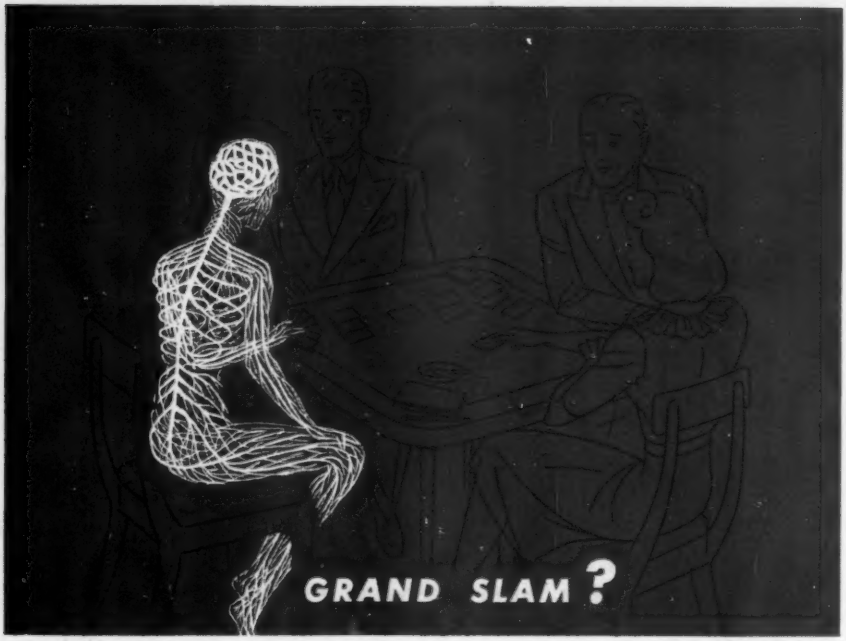

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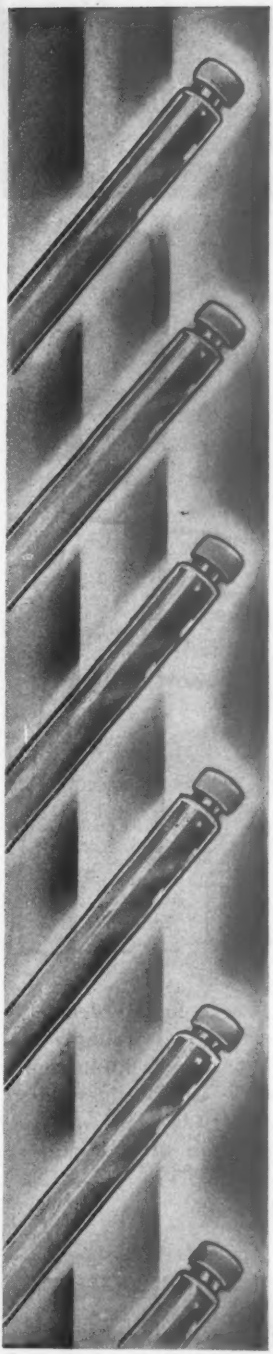

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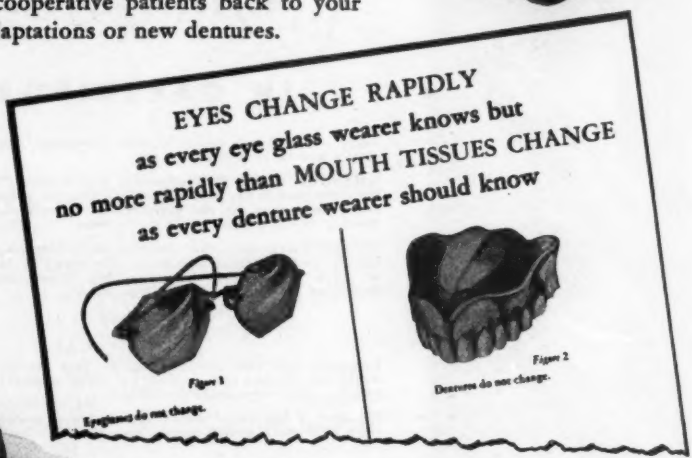
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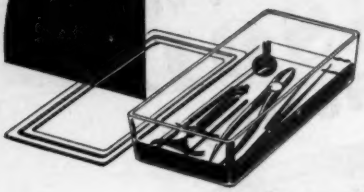

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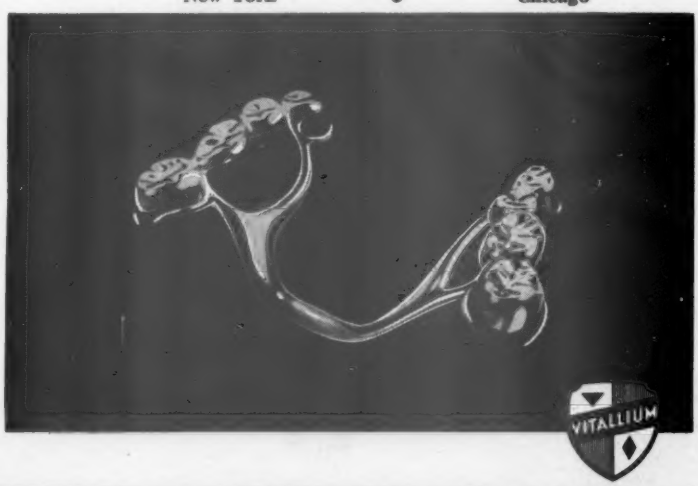

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(1) 1936. Mass. Agr. Expt. Sta. Bull. No. 338.
1937. Chemistry of Food and Nutrition, Fifth Edition, H. C. Sherman, MacMillan, N. Y.
1938. Nutrition Abstracts and Reviews 8, 281.
1939. Food and Life Yearbook of Agriculture, U. S. Dept. Agr., U. S. Government Printing Office, Washington, D. C.

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1 Elvehjem, C. A. — Nutritional Requirements of Man — Ind. & Eng. Chem., June 1941.
2 McCollum, E. V. — The Newer Knowledge of Nutrition — 5th Ed., 1939, p. 392.
3 McLester, J. S. — Nutrition and Diet in Health & Disease — 3rd Ed., 1939, p. 91.
4 McCollum, E. V. — The Newer Knowledge of Nutrition — 5th Ed., 1939, p. 320.

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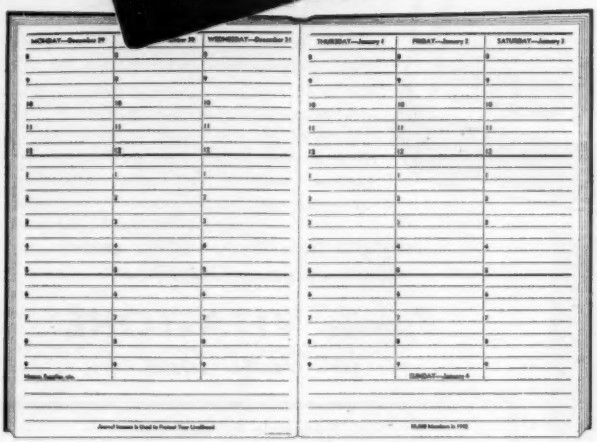

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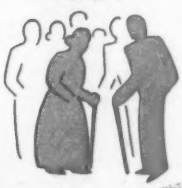

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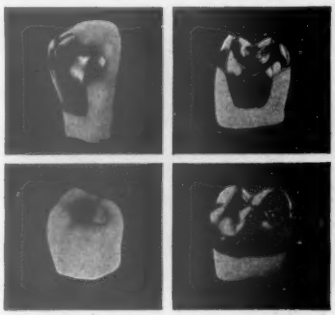

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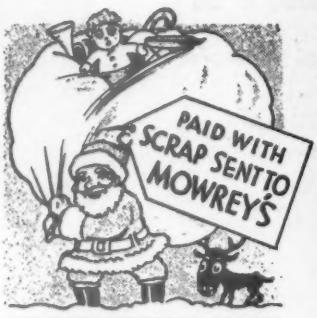

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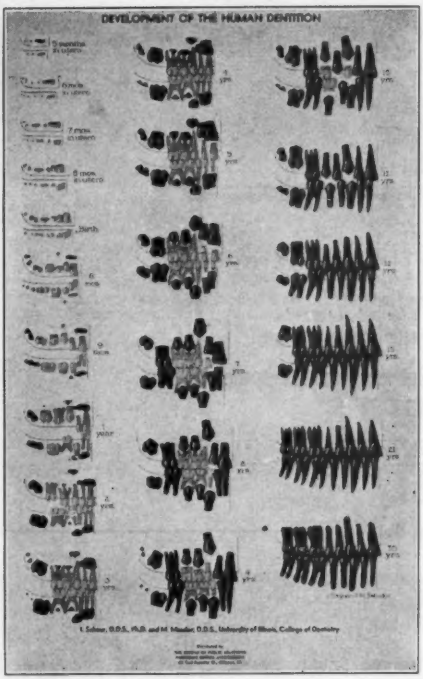

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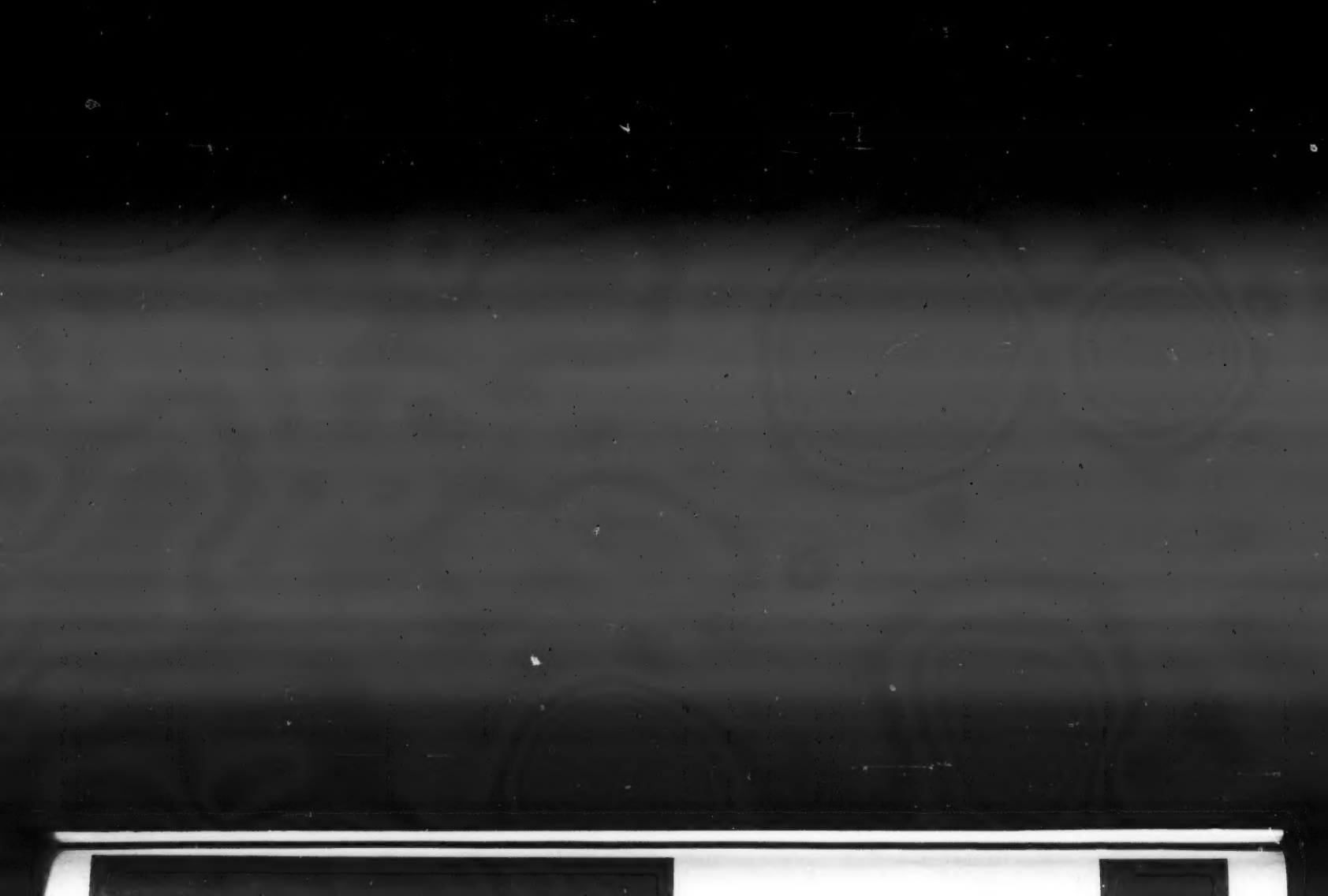
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